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Building the Tough-Oakes Mill--I

By John A. Baker*

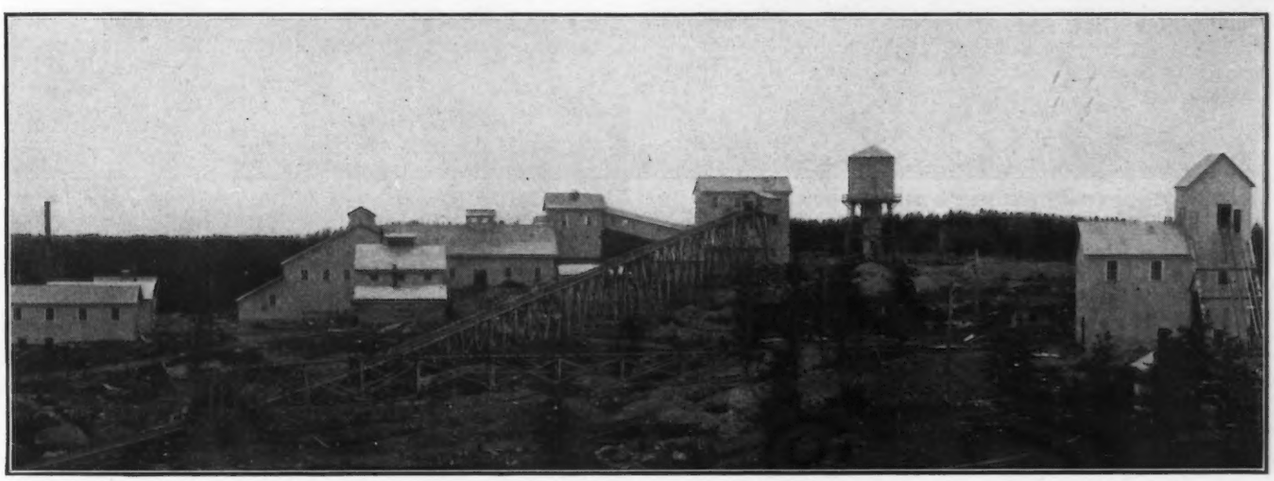
SYNOPSIS—In building the Tough-Oakes mill, a 100-ton cyanide plant, arrangements were made for keeping a detailed chronological record and a segregated cost account. Cost of ground clearing, concreting for foundations, building construction, and general costs are given with extreme clarity, the time factor also being definitely determined.

The property of the Tough-Oakes Gold Mines is in the Kirkland Lake gold area, in the district of Timiskaming, Ont., Can. This district is about 50 mi. north of Cobalt, and the Tough-Oakes mine, at present the sole producer, is in the eastern portion of the area, between Kirkland and Gull lakes. A good wagon road, built by the Ontario government, connects the mine with the village of Swastika, about seven miles away, on the main line of the Temiskaming & Northern Ontario Ry. The area is just south of the Height of Land, separating the waters of the St. Lawrence from those of Hudson Bay. Crushing at the newly constructed 100-ton cyanide plant of this company was begun on Mar. 15, 1915, slightly over three years from the date of discovery of gold on the property and 29 months from the inception of mining operations there.

Development of the Tough-Oakes property progressed through the ordinary steps usual in such cases, including the construction of a small amalgamating mill; but the prospective value of the mine increased so rapidly that the present mill was decided upon and construction begun in a much shorter period than is usual with mines of the kind. The customary cyanide experiments and grinding tests were made. These, together with the quick-setting properties of the ore, indicated that the continuous counter current decantation process was applicable. Ball-mill crushing was looked upon with favor on account of the low first cost and the success of some similar mills at Porcupine. In view of guarantees given by manufacturers it was decided to install Hardinge ball mill instead of stamps.

The Butters-Johnston Engineering Syndicate was engaged as consulting engineers and metallurgists.

The necessity for having the mill in operation at the earliest possible moment led Mr. James Johnston to accept the opinion already arrived at as regards process and machinery, this opinion being later corroborated by the experimental tests made by his company.



SURFACE PLANT OF THE TOUGH-OAKES MINE, KIRKLAND LAKE, ONT., SHOWING THE SHAFT HOUSE, MILL BUILDINGS, TRESTLES AND BOILER PLANT

While the utmost economy was aimed at in all that pertained to the designs and their execution, quality in machinery and material was never sacrificed to cheapness where any advantage or efficiency in operation was to be gained by the former.

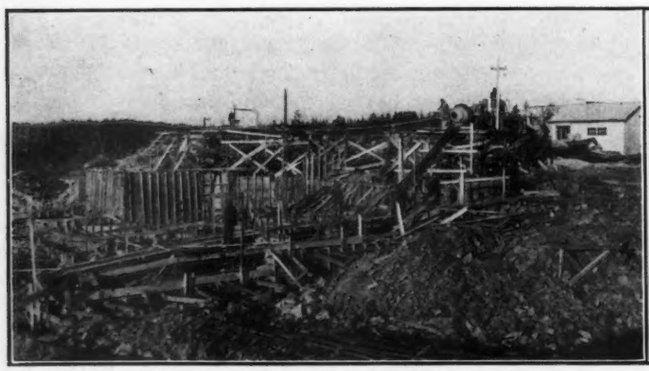
Since the doubling of the mill was considered a not remote possibility, provision was made in the organic design and in power line, transformer station and pipe lines for this contingency. Particular care was taken with the estimate, and a detailed cost-keeping system was installed. A construction schedule was drawn up, and shipments of machinery were planned in accordance with it. By this means it was possible to estimate the monthly

*Formerly Construction Engineer, Tough-Oakes Gold Mines, Ltd.

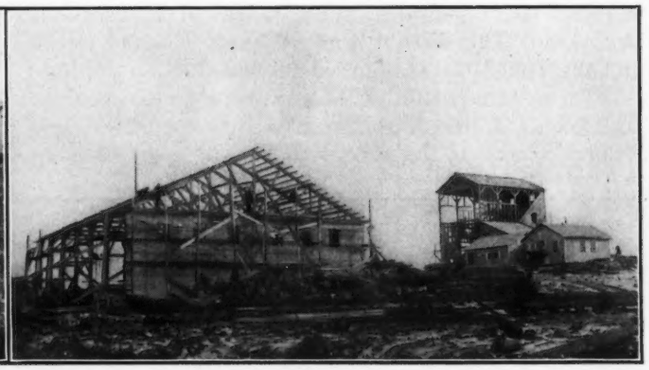
expenditures considerably in advance, thus aiding financial arrangements. A careful daily diary, or log, of all events taking place at the mill site was written up each day. This record enabled the construction engineer to look back and visualize the state of progress at any time, and from that intelligently to predict future progress. It contains the starting and finishing date for every portion of the work, record of arrival and supplies of machinery, had many valuable data, particularly regarding the time factor, which in the rush of construction work is usually lost unless its systematic recording is insisted upon.

General Description of Site and Mill

The mill is on a rocky gently sloping hillside about 1,000 ft. north of the main shaft. From this shaft the ore is delivered along an inclined trestle by a self-dumping skip. An intermediate pocket permits handling ore from No. 3 shaft over the same trestle. The crusher station occupies a separate building connected with the cyanide plant by an overhead conveyor. The cyanide plant is built in the shape of a letter L, the eastern wing comprising the fine-ore bin, ball mill, tube mills and plates and is referred to as the fine-grinding department. The main building houses the tanks, pumps and accessory apparatus.



POURING THE CONCRETE MILL FOUNDATIONS THROUGH A CHUTE FROM THE MIXER



CONSTRUCTION OF TANK ROOM, CRUSHER STATION IN THE BACKGROUND

In the crusher station run-of-mine ore is reduced to 1¼-in. ring by two jaw crushers, with intermediate elevating and screening. The crushed ore is delivered by belt conveyor to the fines-storage bin at the end of the fine-grinding department. From it push feeders deliver to a short conveyor feeding the ball mill. The ball-mill product is split between two duplex Dorr classifiers, each operating in closed circuit with a 5x20-ft. tube mill. An elevator and copper plates are provided, so arranged that the plates may be interposed between either tube-mill discharge and its classifier. The classifier overflow runs by gravity into a 30x10-ft. Dorr thickener. The overflow of this machine, constituting the pregnant solution, gravitates to a box containing canvas leaves for clarifying. From this a vacuum pump delivers the clear solution to a sump, from which it is drawn for precipitation. The zinc-dust system is used.

Thickened pulp from the bottom of the 30x10-ft. collector thickener is transferred by diaphragm pumps to three 16x12-ft. agitators operating continuously in series. The pulp from the third agitator gravitates to the first of four 28x10-ft. Dorr thickeners, operating on the continuous counter-current decantation principle. Each tank is 24 in. higher than the preceding one. The overflow runs by gravity, while the thickened-pulp transfers are effected by diaphragm pumps. From the final tank the thickened pulp is discharged by spigot into a launder, whence it runs through a mechanical sampling device and then to waste.

Below and to the west of the cyanide plant are the heating boiler, transformer house and the carpenter and machine shops. Next to the crusher station are the office and storehouses, water tank and lime bin. All these auxiliary buildings, together with the water-service pipe, 2,200-volt mill-feeder line and trestle are included under the general heading of mill construction in the original estimate. The refinery and oilhouse were added later when the financial situation had improved.

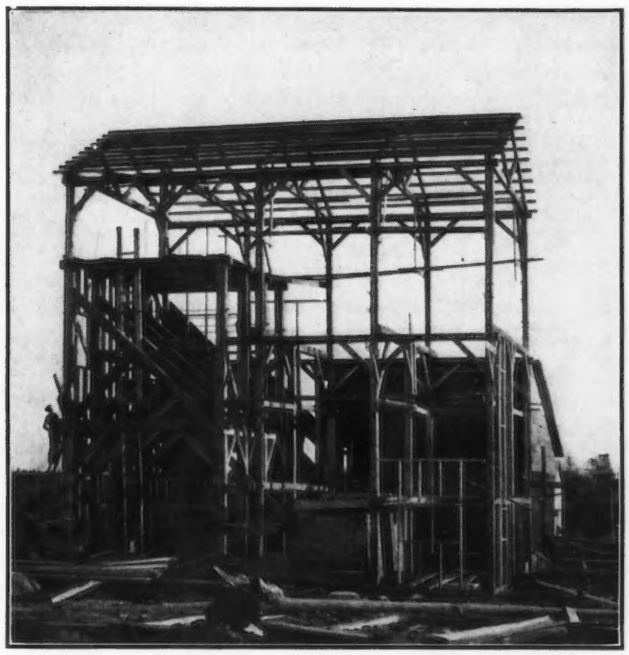
Clearing and Excavating for Foundations

Clearing of stumps and removing of soil was commenced on July 27, 1914, with a gang of 12 laborers and one team. Under about 6 in. of top soil a tough boulder clay was encountered. Work was found to progress most satisfactorily when using two teams and about a dozen men. The soil was deposited about 100 ft. outside the lines of the building, where it could be recovered handily for filling purposes. On portions of the work wheelbarrow runways were employed instead of teams, to dispose of material. Frequent boulders and the uneven nature of the ground prevented the use of scrapers or similar devices. The average depth of the overburden over the whole area cleared was 2 ft., giving a total of 1,278 cu.yd. The cost of the work was: Labor, $820.19; material, $99.60; total, $919.79; or 72c. per cu.yd. Laborers were paid at the rate of $2.25 per day.

Work on rock excavation was begun immediately, using hopper drills of the hand-rotated type. After Sept. 1, air was supplied from the original small steam plant, so that its cost per machine per shift was higher than when the large electric compressor was running, the exact figure being $3.50. There was no cut more than 6 ft. deep, but it was necessary to cut down from 1 to 2 ft. over nearly 60% of the area of the cyanide plant. A total of 125 machine shifts was necessary, and the complete work of rock excavating was not finished until Oct. 1, making an average of three machine shifts per day. Owing to the great irregularity of the rock surface, no close estimate of rock removed, based on cross-sections, can be given. The figures given herewith are believed to approach accuracy to within 15%: Total yardage, 547; labor and material, $3,001; cost per yard, $5.52. The rock was nearly all conglomerate.

On Sept. 20, while the drills were still working on the lower floor of the cyanide plant, carpenters commenced work on the crusher-station forms. Since the topography of the mill site is something over which the construction engineer had no control, the actual work of the mill construction may be said to start from this date.

One-inch rough lumber costing $24 per M laid down at the mill site was used in the forms. On walls up to 4 ft. high, 2x4-in. scantling on 18-in. centers was used. On walls 4 ft. to 10 ft. high, 2x6-in., 16-in. centers, securely tied together with concrete wire, was employed. On the main retaining wall between the fine-grinding department and the cyanide plant 2x8-in. timbers on 16-in. centers were found necessary to make the forms secure. This wall is 12 to 14 ft. in height. The uprights were tied from back to front in three places with soft-iron concrete wire. A rough reinforcement consisting of strands of old cable was fastened to these tie wires. This



THE CRUSHER STATION IN CONSTRUCTION STAGE

wall was given a batter of 1 in. per ft. The other walls, which varied in thickness from 6 to 12 in., were built with vertical sides.

All tanks are supported on packed rock and earth fill held in place by small retaining walls. Since all the tanks are on different elevations and since it is necessary to have a channel to the center of each thickener, the foundation plan presents a rather complicated appearance. This method, however, is much more economical than that using individual piers with timber beams and joists. The center channels are run obliquely, so that there will be only one elbow in the diaphragm-pump suction line.

All concrete was mixed in a Smith mixer of ⅓-cu.yd. capacity. The mixer was driven by steam from a 20-hp. locomotive boiler temporarily erected for construction purposes. The total for all walls, floors and piers was 445 cu.yd., divided among the several buildings as follows: Crushing station, 70; fine-grinding department, 135; cyanide plant, 215; water tank, 5; heating plant, 20; total, 445 cu.yd. Four different set-ups of the mixer were necessary. All the main walls and piers were spouted direct from the machine through wooden launders lined with galvanized iron. Some of the smaller walls were filled by wheelbarrow. A modern spouting equipment with steel chutes, hoist and tower, would have saved $200 in the placing of the concrete—not more. This, however, would have involved either a large outlay for equipment or the letting of the work by contract, which was for many reasons undesirable.

The mixture desired was 1 part cement, 3 of sand and 5 of rock. Large piers and walls were given as much additional coarse clean rock as they would stand. The rock used was from the main waste dump about 400 yd. away. It was hauled by team to the mill site and used without crushing or screening. The problem of securing suitable sand was not so simple. Two sources of supply were available and screen tests showed the results given in the accompanying table.

COMPARISON OF SANDS AVAILABLE FOR CONCRETE

	No. 1—Lake Sand, %	No. 2—Trench Sand, %
On 10-mesh	13.9	5.9
On 20-mesh	21.1	6.3
On 40-mesh	21.7	11.3
On 60-mesh	25.7	20.4
On 80-mesh	8.2	27.7
On 100-mesh	3.0	4.2
Through 100-mesh	6.2	22.7

No. 1 sand was two miles from the mill, was coarse and of a reddish color and seemingly the best. No. 2 sand was half a mile from the mill and was almost pure white. Despite the large proportion of —100-mesh it settled quickly in a glass of water, showing little or no colloidal matter. Test bricks were made from both sands without coarse aggregate, and that made with No. 2 appeared considerably the sounder of the two. It was finally decided to mix them in the proportion of 25% of No. 1 to 75% of No. 2. The resulting concrete was sound in every instance.

All floors were laid after the completion of the building and the installation of the heating system. As this was during January and February, hand mixing inside the building was resorted to. Floors were laid 5 in. thick in the usual proportion and then a surface coat ½ in. thick, of 1 of cement to 2 of screened sand, was floated on.

DATA ON CEMENT USED IN CONCRETE WORK

Total cement used	2,736 bags
Total cost of cement	$2,042.85
Cost per bag	0.74
Bags per yard	6.1
Total cost labor, $4,350.33; material, $2,870.31	$7,220.64
Total yardage including floors	445 cu.yd.
Cost per yard	$16.23

In this total cost of concrete no proportion of office, consulting, or general supervision expense was added and no credit is taken for the lumber rescued from the forms and used later in the building.

Sequence Planning for Rapid Construction

Returning now to the chronological description of the work, Sept. 25 saw the completion of the crusher-station forms and a start on those of the cyanide plant. Concrete pouring began on Oct. 2, and as soon as the crusher station was completed the mixer was shifted down to the next set-up and the forms filled as fast as finished. Form building was completed on Oct. 14 and the concrete on Oct. 15.

On Oct. 2, the same day on which concrete pouring was commenced, the framing of the crusher station was begun with a gang of six carpenters. On Oct. 12 the work of erection was commenced. The design of the building

permitted assembling the various members of the structure into frames or bents. The latter were then hoisted into their proper position with a gin pole and small hoist. On Oct. 20 the frame was up and sheeting had commenced.

The posts under the ore bin and the members of the ore-bin frame are 10x10-in. timbers. All other posts are 8x8-in. Mortise-and-tenon construction is employed throughout except on knee braces and roof trusses. In these the members are halved and bolted. All horizontal splices are ship splices, bolted with four 5/8-in. bolts and tightened with tapered hardwood wedges. All vertical splices are plain halved joints 24 in. long. The main plant consists of three buildings—the tankroom, fine-grinding department and the fine-ore storage bin. The main building, or tankroom, consists of a main span of 62 ft. with a shed addition 18 ft. wide along the western side, making a total width of 80 ft. It is 114 ft. in length. The fine-grinding department is 52 ft. long, with a span of 50 ft. The building has a general "L" shape, with limbs of 114x155 ft.

Working from both ends of the "L" with separate gangs of carpenters, the process of erection went forward rapidly. The completion of the crusher station was held in abeyance and every effort made to finish the cyanide-plant building so that the work of tank erection might be

TABLE 1. CYANIDE-PLANT AND CRUSHER-STATION COSTS

Building	Nature of Work	Labor	Material	Total	Supervision	Insurance	Heating	Total
Crusher station	Clearing, excavations and foundations	$1,098.56	$1,065.29	$2,163.85	.....	.....	.....	.....
	Building and erection	1,773.16	1,732.96	3,506.12	.....	.....	.....	.....
	Machinery and equipment	1,792.24	5,786.73	7,578.97	.....	.....	.....	.....
	Electrical equipment	65.60	856.68	922.28	.....	.....	.....	.....
	Heating system	109.77	248.48	358.25	.....	.....	.....	.....
	Crusher station, total	$4,839.33	$9,690.14	$14,529.47	$1,159.65	$43.52	$311.31	$16,043.95
Cyanide plant	Clearing, excavations and foundations	$6,832.11	$2,297.28	$9,129.39	.....	.....	.....	.....
	Building and erection	4,624.97	4,815.65	9,440.62	.....	.....	.....	.....
	Tanks	2,866.56	5,100.00	7,966.56	.....	.....	.....	.....
	Machinery and equipment	7,316.44	35,287.77	42,604.21	.....	.....	.....	.....
	Heating system	731.45	2,800.95	3,532.40	.....	.....	.....	.....
	Electrical equipment	559.09	5,789.03	6,348.12	.....	.....	.....	.....
	Cyanide plant, total	$22,930.62	$56,090.68	$79,021.30	$3,865.98	$145.07	$1,037.74	$84,070.09
	Combined total	27,769.95	65,780.82	93,550.77	5,025.63	188.59	1,349.05	100,114.04

Labor cost was 33% and material cost 67% of the total. Dividing into classes, the cost of supervision and insurance was 5.1%; clearing excavations and foundations, 11.3%; building and erection, 12.9%; tanks 8%; electrical equipment, 7.3%; heating during construction, 1.3%; heating system 3.9%; machinery and equipment, 50.2%.

TABLE 2. CONSTRUCTION COSTS

Building	Nature of Work	Labor	Material	Total	Supervision	Insurance	Heating	Total
Office	Building, furniture and fixtures	$253.05	$580.75	$833.80	.....	.....	.....	.....
	Heating system	14.58	43.44	58.02	.....	.....	.....	.....
	Total	.....	.....	.....	$60.00	$4.85	$69.18	$1,025.85
Storehouse	Building and fixtures	177.98	372.86	550.84	.....	.....	.....	.....
	Heating system	6.03	20.00	26.03	.....	.....	.....	.....
	Total	.....	.....	.....	50.00	4.85	69.18	700.90
Transf'rm'r sta.	Building and erection	192.08	367.03	559.11	.....	.....	.....	.....
	Electrical equipment	171.17	3,508.15	3,679.32	.....	.....	.....	.....
	Total	.....	.....	.....	250.00	14.51	.....	4,502.94
Lime bin	Building and erection	268.08	176.87	444.95	50.00	4.85	.....	499.80
Water tank	Foundations and substructure	537.12	434.50	971.62	.....	.....	.....	.....
	Tank and piping	191.60	608.18	799.78	120.00	4.83	34.10	.....
	Total	.....	.....	.....	.....	.....	.....	1,930.33
Carpenter shop	Building and erection	198.83	355.82	554.65	.....	.....	.....	.....
	Heating system	25.59	46.03	71.62	.....	.....	.....	.....
	Total	.....	.....	.....	50.00	4.83	86.97	768.07
Machine shop	Building and erection	259.02	464.91	723.93	.....	.....	.....	.....
	Equipment	183.27	1,256.33	1,439.60	.....	.....	.....	.....
	Heating system	53.98	107.37	161.35	.....	.....	.....	.....
	Total	.....	.....	.....	168.53	4.83	86.97	2,585.21
Power line	Erection and material	420.16	712.00	1,132.16	80.00	.....	.....	1,212.16
Trestle	Erection and material	1,505.52	1,038.17	2,543.69	200.00	4.83	.....	2,748.52
Water line	Excavation and pipe laying	1,414.89	876.69	2,291.58	180.00	.....	.....	2,471.58
Heating plant	Clearing and foundations	222.60	93.81	316.41	.....	.....	.....	.....
	Building and erection	265.45	358.30	623.75	.....	.....	.....	.....
	Boiler setting, boiler piping	759.09	1,313.70	2,072.79	.....	.....	.....	.....
	Total	.....	.....	.....	208.95	4.83	34.09	3,260.82
Combined totals		$7,120.09	$12,734.91	$19,855.00	$1,417.48	$53.21	$380.49	$21,706.18

roof-truss members are 4x8 in., and the roof has a 1/4 pitch. Splices in truss members are fishplated, using 3x1/2-in. iron. Studding and purlins are of 2x6-in. timber on 24-in. centers. The sheeting of 1-in. rough lumber is put on diagonally to increase the stiffness. Floors are of double thickness—a layer of 1-in. boards being overlaid with another of 2-in. rough planks. The cornice is boxed in with 7/8-in. dressed lumber. A carefully made cornice is essential to economical heating, with the winter conditions obtaining in northern Ontario. Roof and walls are first covered with 16-oz. tar felt and then with No. 28 gage corrugated galvanized iron.

Erection work on the cyanide-plant frame was commenced on Oct. 22. The roof truss for the main 62-ft. span was completely framed on the ground and then lifted into position. Each truss weighs 2,200 lb. The main members are 4x10 in., but in all other respects the construction details are similar to those of the crusher station. From a structural point of view the cyanide

started. The last roof truss was put in place on Nov. 4, and by Nov. 10, sheeting was finished so that the steel-tank erection could be commenced.

On Nov. 24 ventilators, windows and doors were in place and cornice and corrugated-iron work was completed. The time elapsed since starting on crusher-

TABLE 3. TOTAL CONSTRUCTION COSTS

Month	Direct Labor Cost	Total Cost
July	$165.02	$243.80
August	1,332.06	3,297.33
September	2,217.52	5,470.11
October	5,327.84	11,389.53
November	4,942.72	31,728.66
December	3,695.97	30,139.72
January	5,169.64	19,696.79
February	5,283.05	15,834.11
March	2,789.33	3,098.93
April	358.86	921.24
	$31,282.01	$121,820.22

station forms was 65 days. Time required to erect cyanide-plant and crusher-station buildings on completed foundations was 33 days. The cost of erecting these build-

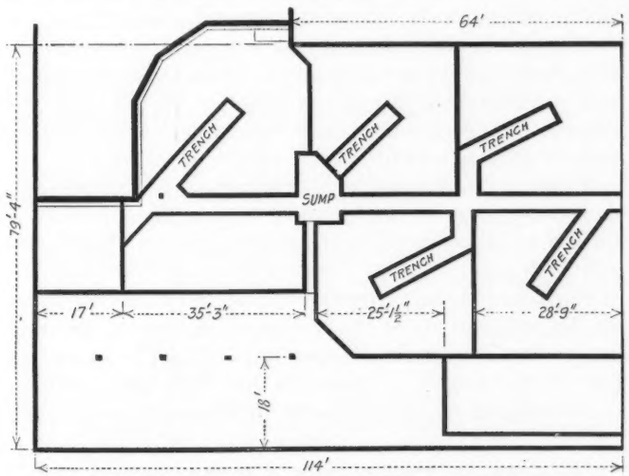
ings is shown on the table of summarized cost of the mill construction, but is repeated here with additional data.

TABLE 4. COST OF BUILDING ERECTION

	Board Measure, Ft.	Labor, $	Material, $	Total, $	Per Cent. Labor in Cost	Volume, Cu.Ft.	Cost per 1,000 Cu.Ft.
Crusher station.	45,000	1,773.16	1,732.96	3,506.12	50.5	43,500	$80.00
Cyanide plant...	192,000	4,624.97	4,815.65	9,440.62	49.0	257,000	36.00

The great difference in cost is due to the fact that the crusher station has two wooden floors above the basement, the upper one of which has to carry a heavy load. On this account center posts, beams and heavy joists are provided. Also the trussed conveyor bridge and the scalehouse addition (also trussed) are included in the crusher-station cost. As they involve a larger amount of material and labor in proportion to their volume than straight building construction, they have operated to raise the cost per unit of volume. Again, the ore bin comprises a larger proportion of the crusher station than does the ore bin in the cyanide plant.

While the work on the crusher station was just as efficiently done as in the larger buildings, as indicated by labor-material ratio, the figure $80 per 1,000 cu.ft. of volume will hardly have a wide application to other construc-



TANK-FOUNDATION PLAN AT TOUGH-OAKES MILL

tion operations, owing to the peculiar conditions at Tough-Oakes. On the other hand, the figure $36 per 1,000 cu.ft. is one which probably can be used as a basis for estimating on similar construction. The basic prices are: Lumber, $24 per M; galvanized iron, $3.50 per square; carpenters, $3.25 per 9-hr. day. Since labor and material are roughly half and half, any marked variation in either commodity can be easily allowed for in estimating. It is assumed, of course, that the lightest design consistent with strength and rigidity will be employed.

Small buildings cannot be estimated on the same basis as the more pretentious ones, as is shown by Table 5. These buildings are all of the balloon-frame type except the machine shop, which has a light truss of 6x6-in. lumber. Floors are double thickness, and all studs and rafters are 2x6 in. Buildings made of 2x4-in. material are found to depreciate rapidly after the first year.

TABLE 5. COST OF SMALL BUILDINGS

Building	Labor, $	Material, $	Total, $	Per Cent. Labor in Cost	Volume, Cu.Ft.	Cost per 1,000 Cu.Ft.
Transformer station.....	192.08	367.03	559.11	32	7,800	$72
Machine shop.....	259.02	404.91	723.93	36	12,500	58
Carpenter shop.....	198.83	355.82	554.65	35	8,000	69
Heating plant.....	265.45	358.30	623.75	42	9,800	64
Total.....	915.38	1,546.06	2,461.44	37	38,100	$65

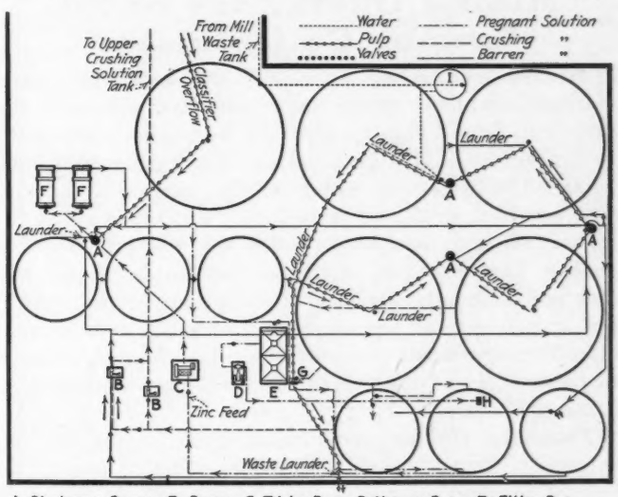
The percentage for labor is in all cases smaller than for the main buildings.

The erection of the steel tanks was begun on Nov. 12. The buildings were closed but not heated, and the weather continued mild. The complete list of tanks is shown in the accompanying table.

LIST OF TANKS IN CYANIDE PLANT

1—30x10-ft. steel tank with overflow ring.
4—28x10-ft. steel tanks with overflow ring.
3—16x12-ft. plain steel tanks.
3—16x10-ft. plain steel tanks.
1—20x10-ft. plain steel tank.

The total number of rivets came to 35,000, and the estimated weights varied from 140,010 lb. to 129,935, with different manufacturers. The price at which the contract was let called for the laying down of the material at Swastika station, 400 mi. north of Toronto at 3.13c. per lb., and erection an additional 1.5c. per lb. In this contract the purchaser was called upon to supply and erect such scaffolding as was necessary, as well as to provide compressed air for pneumatic tools. All tools, forges,



A=Diaphragm Pumps B=Pumps C=Triplex Pump D=Vacuum Pump E=Filter Box
F=Filter Presses G=Tailing Sampler H=Measuring Device I=Constant-head Tank

TANK ARRANGEMENT AT THE TOUGH-OAKES MILL

chain-blocks and labor of erection were provided by the contractor.

The complete cost of the tanks erected on the foundations amounted to 5.3c. per lb., made up as follows:

COST OF TANKS ERECTED

Tank material f.o.b. station	$4,390
Cartage to mill site	240
Riveting and erection contract	2,100
Power, labor and material, supplied by the company on erection contract	766
Total	$7,496

The erecting gang at first consisted of the boss erector and three men, using one riveter. It was soon found that progress was too slow and another four men, using another riveter and a calking machine, were added. These men subcontracted a portion of the work at the rate of 1½c. per rivet for ⅝ rivets, and 1¼c. per rivet for ½-in. rivets. On this character of work 600 rivets per day for a gang consisting of heater, riveter and bucker-up was found to be good work.

The bottoms of all tanks were calked on the inside and tested with about 4 in. of cold water. All joints are metal to metal, no tar paper or other filler being used. Any leak which showed over 1 drop in 20 sec. had to be remedied before the tank was accepted and lowered into position. The rivets in the side plates and the calking were passed on by inspection, as sufficient water for filling

a tank was not available. The bottom plates of the tank rest on 2x8-in. planks spaced 6 in. apart on packed-earth fill. The work was completed on Jan. 7, a total of 54 working days. A rectangular steel box with hopper bottom for holding clarifying-filter leaves was also erected during this period.

The tabulated construction costs are shown in Tables 1 and 2. Both direct labor and cost by months is shown in Table 3. Actual labor is slightly higher, owing to some distributed charges. Material was charged to mill construction on arrival at mill site. The total cost of the entire mill construction was $121,820.22, against an estimated cost of $124,840. Regular operations began Mar. 15, about two weeks ahead of the construction schedule at first adopted. No mechanical difficulties or other troubles were encountered, and the mill went smoothly into operation.

(To be concluded)

Mining Operations of the Granby Consolidated

For the year ending June 30, 1915, according to the company's annual report only recently published, the shipments from Phœnix and Grand Forks, B.C., amounted to 611,000 tons. The output from the Phœnix mines was curtailed considerably owing to the war. The mining cost was 85c. per ton of ore shipped, which was about 5c. higher per ton than the average for the previous five years. This was due partly to the shutdown last fall and the subsequent starting of operations in the winter, but it also reflects the increasing expense of extraction attending decreasing ore reserves. The reserve tonnage in these mines at the end of the fiscal year amounted to 4,232,405 tons.

From the Hidden Creek mine at Anyox, B. C., the shipments for the year amounted to 477,435 tons. The cost of mining per ton of ore shipped was $1.03. The ore reserve, which assayed 2.2% copper, was, at the end of the year, 9,205,837 tons. There was a further reserve of low-grade copper ore, averaging 0.63% copper, amounting to 8,628,000 tons.

At the Bonanza mine, about two miles up Bonanza Creek, south of the smeltery, nothing was done during the year either in the way of development or in preparation for shipping ore. The ore roughly blocked out by the work previously done on the property, averaging 2.6% copper, amounts to 414,775 tons. There is in addition 489,580 tons of low-grade ore that averages 0.7% copper. The company owns the Mamie and Dean mines on the Kasaan Peninsula of Prince of Wales Island, southeastern Alaska, and has an option to purchase the It mine adjoining the Dean. Work was resumed on these properties in April, 1915, after having been discontinued since the beginning of the European War.

Following the characteristics of the known copper mines in this vicinity, these mines are comparatively small. However, the results of the work on them has given sufficient encouragement to warrant the continuation of prospecting for, and seeking the extension and enlargement of, the known orebodies. From these mines there was shipped during the fiscal year 15,000 tons of ore averaging 1.5% copper. The reserve showings are 130,000 tons, with a fair prospect of developing treble this tonnage by future work.

At the Midas mine, Valdez, southwestern Alaska, work was started in April, 1915, to complete the aërial tramway, the mine terminal of this tramway, a few buildings at the mine, and to fill in about the pile foundation of the wharf shipping bins—to prevent destruction by teredos. This work is about completed, and with the little development work that has been done in the mine during the year, this property will be ready to make shipments as soon as arrangements are made for securing power to operate the air compressor.

The Origin of the Bingham Disseminated Ores

In a paper entitled "The Disseminated Copper Ores of Bingham Cañon, Utah," to be presented at the New York meeting of the A. I. M. E., February, 1916, by J. J. Beeson, the conclusions drawn as to the formation of the important sulphides in the disseminated ores are:

Pyrite, chalcopyrite, and probably a minor amount of bornite are the primary copper minerals. The primary sulphides do not occur in these ores as magmatic sulphides, but owe their present distribution to the magnetite which was a magmatic mineral.

Covellite is the most abundant secondary copper mineral, forming by a replacement of chalcopyrite in slightly acid to neutral solutions. Chalcocite is the most important secondary copper mineral, formed under slightly acid to alkaline conditions.

Secondary chalcopyrite may be an indeterminate mineral between pyrite and chalcocite, and bornite may be formed as an indeterminate product between chalcopyrite and chalcocite.

Secondary chalcopyrite and bornite may also be formed by the replacement of the copper in chalcocite, or covellite by the iron of the ferrous sulphate. The concentration of the ferrous sulphate in the descending solution is probably an important factor in secondary enrichment.

Le Pas District in Manitoba

TORONTO CORRESPONDENCE

The Le Pas mineral area in northern Manitoba which has lately attracted some attention is about 74 mi. north of Le Pas, commencing near the Manitoba-Saskatchewan boundary and extending eastward for about 125 mi. toward James Bay, and is about 50 mi. in width. The formation is Huronian, largely conglomerate and Keewatin schist and lies between limestone strata on the south and granite to the north. The deposits contain iron, zinc, copper, lead, gold and silver.

The most noteworthy discoveries have been made in a sulphide area about 25 mi. from Beaver Lake, the western extremity of the belt, where a surface outcrop of 1,000 by 200 ft. has so far been traced, the ores containing in addition to good gold and silver showings, zinc, lead, copper and iron. A large portion of this area has been staked by J. E. Hammill, W. J. Currie, Alexander Fasken and other prospectors. The Beaver Lake Mining Co.'s location is at the extreme west end of the belt, and 50 mi. east of the sulphide area. The Island Lake group of prospects have been located by Sam Otisse and M. J. Hackett. The new Hudson Bay Ry. will run close to the Le Pas mineral belt.

Notes on Shrinkage Stoping

By E. H. Dickenson and H. J. Volker*

SYNOPSIS—Details of methods for mining large deposits whose walls need support other than floor pillars and those whose walls need only floor pillars for support. At these mines under observation where rock was hard, speed of drilling with hammer drills was not equal to piston machines.

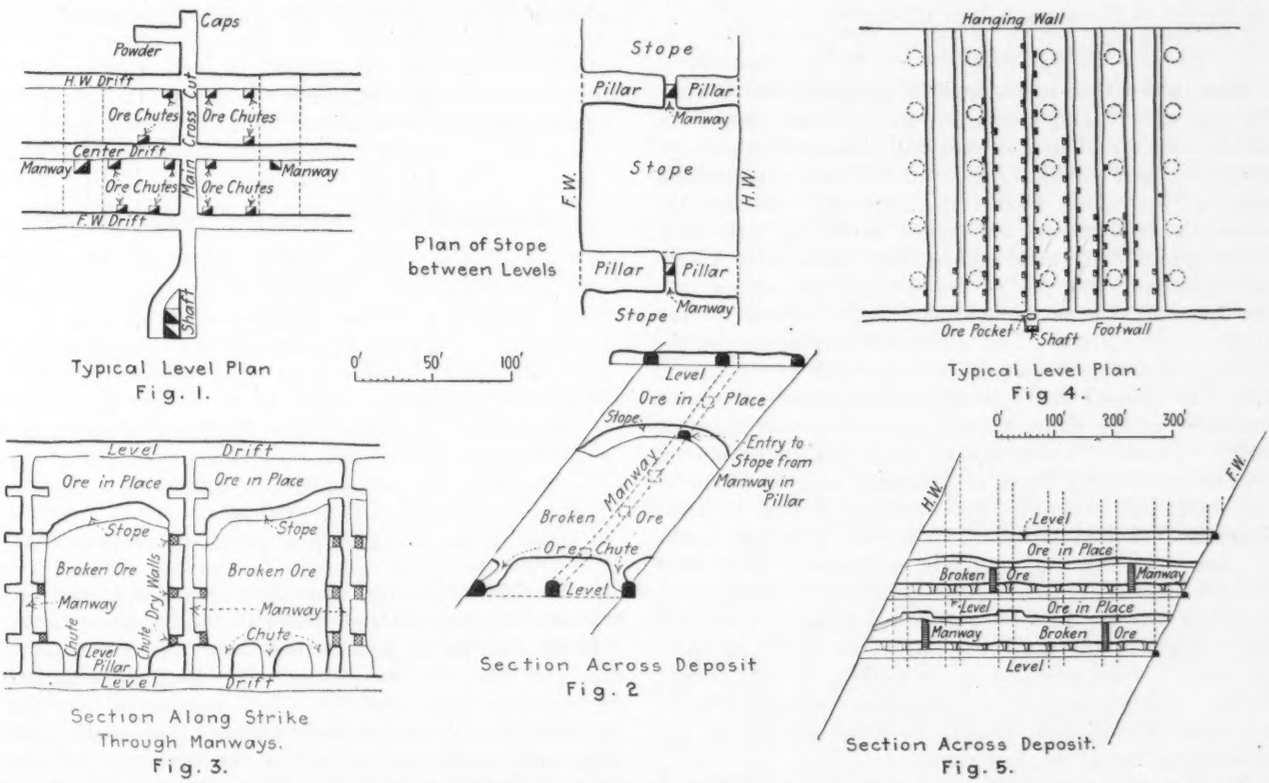
In shrinkage stoping the miner stands on the broken ore, enough of which is left in the stope to keep the back within easy reach of his machine. This means that after work is fairly started, only the excess in volume of broken ore over ore in place is drawn. The unavoidable accumulation of broken ore in the stope is one of the disadvantages of the system. Where the dip is sufficient, however, to permit a ready flow of the broken ore on the foot wall, where the wall rock does not slough off unduly and where the distribution of mineral is such that only negligible quantities of waste are likely to be mixed with the ore, the mining of the orebody may be accomplished by this method. While practically any width of deposit may be so attacked, deposits of the "narrow" vein type are not usually mined by this method, since such veins are often spotty and too high-grade to allow the broken ore to remain idle in the stope with economy. There is no physical reason why the method cannot be used even here. This article, however, has to do mainly with large low-grade deposits.

The dominating feature governing the details of the methods observed is the strength of the wall rock. A fair amount of strength of back is always essential. The haulageways may be run either across or along the orebody, but in each instance they must be close enough together to permit even drawing of the ore.

This discussion is divided into two parts: (A) Mining large deposits whose walls need support other than floor pillars. (B) Mining large deposits whose walls need only floor pillars for support. Only brief mention will be made of other types.

Development of Class A

Such a type may be represented by a deposit 100 ft. wide dipping at 50° and suited, both in grade and distribution of mineral, to be attacked by this method. Figs. 1 and 2 show a suitable arrangement of drifts, ore chutes and crosscuts in which the main haulageways are run parallel to the strike. The ore is drawn from the stopes into three drifts, which feed into a main crosscut and thence to the shaft. Ore chutes are put up about 20 ft. from the floor of the drift and are 15 to 30 ft. apart, depending on the ease with which the ore flows in the stopes. At intervals of 100 ft. along the center drift, raises are put up to the next level at the same inclination as the dip. These are used for manways, steel and timber passes and for ventilation. These manways are in the center of a pillar, rectangular in cross-section, which extends from foot to hanging and continues in



FIGS. 1 TO 5. SHRINKAGE STOPING METHODS FOR LARGE DEPOSITS BETWEEN WALLS NEEDING FLOOR PILLARS AND OTHER MEANS OF SUPPORT

*18 Lorne Apartments, Lorne Crescent, Montreal, P. Q.

depth with the mine workings. These pillars are the distinctive feature of this method of handling shrinkage stoping. They furnish the support needed by the walls and incidentally help support the back. They may be about 25 ft. thick. The manway in the pillar has drifts about 10 ft. long in either direction along the strike at intervals of about 30 ft. vertically. These give the men access to the stope as it ascends. A floor pillar of about 20 ft. is also left at each level. A longitudinal section through the center drift in the plane of the vein is shown in Fig. 3.

Another method of development for a deposit of this type is to carry the manways out through the back of the stope and have no raises in the pillars. This method gives better ventilation, but weakens the back and is usually less safe and convenient.

The distance apart of the levels depends upon many considerations. In one instance 150 ft. was the greatest distance that the vertical pillars would stand without crushing before the stope could be conveniently worked out. Sometimes leaving ore too long in the stope causes oxidation that may interfere with milling. Besides these, there are the more common influences that are discussed in any textbook on the subject. This completes the development of the class A type of deposit.

Development of Class B

This type will be represented by a deposit 500 ft. wide, dipping at 75° and similar to the previous deposit in all else except that its wall rock will stand only when supported by floor pillars. Figs. 4 and 5 show one arrangement of drifts, ore chutes and crosscuts. In this instance the haulageways are mainly across the strike. A hanging-wall drift may connect the crosscuts to facilitate haulage. The ore is drawn from the stopes into the crosscuts, thence to the main drift and ore pocket at the shaft station. The chutes are put up as before, 20 ft. above the floor. Pillars are left 85 ft. apart. They are vertical and cylindrical and center one under the other as the mine deepens, until they find the foot wall. In most of these, manways are put up from level to level with short drifts at intervals, to give access to the stope, but sometimes manways are formed by cribbing one of the ore passes. The latter is a cheaper method, but some manways must be maintained from level to level for ventilation. A floor pillar about 25 ft. thick is left as before. In this case special pillars are left for the support of the back, but only floor pillars support the walls. When such a stope is worked out and drawn, it has the appearance of an enormous colonnade 500 ft. wide and of indefinite length, the stope not having the dividing pillars of the first class.

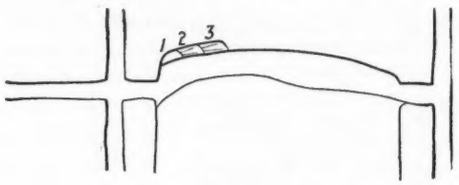
The distance apart of the levels in this case will depend more upon the decision of the mining economist than upon any physical reason, since the determining factor is the interest on the money value of the idle ore versus the cost of extra levels.

The two cases given may be considered briefly as to both wider and narrower deposits. No change occurs in either method as width increases. As width decreases, case A must maintain all its pillars, while as soon as the width is about 75 ft., there is no need of vertical pillars in case B. In narrower veins the floor pillars may disappear in either case, stulls or other timbering furnishing support for the broken ore.

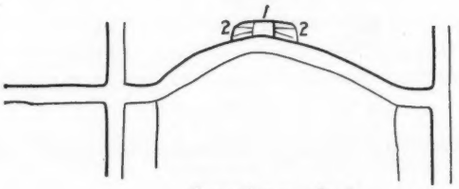
Stoping is started from a short drift either from the top of one of the ore chutes or from the end of the lowest drifts in the manways. This is wall-stoping and is carried on with piston machines. In the first example wall-stoping would be limited to the space outlined by the pillars and walls. In the second example any length could be opened up.

Having enlarged the stope to a suitable size, back-stoping is commenced. The quality of the back will again regulate the details of procedure. Assuming, in case A, a rather treacherous back with horizontal slips, it will be seen that working under overhanging ground would be dangerous. Fig. 6 represents a safe method of procedure. A cut is taken from foot to hanging across the deposit, and piston machines work away from this cut. A more rapid, but not quite so safe, method may be used, as in Fig. 7. The cut in this case is taken across the middle of the stope, and the machines work away in opposite directions. A third method to attack this particular kind of ground is to make a cut across the stope at each end and leave the stope until the intervening slab caves, plugger drills being then used to break it into smaller pieces.

It will be observed that the use of hammer drills is not advisable in a deposit of the peculiarities mentioned,



Side Cut.
Fig. 6.



Center Cut.
Fig. 7.

FIGS. 6 AND 7. METHODS OF BACK-STOPING

for with horizontal slips, vertical or even steeply inclined holes shatter the back and render it unfit to work under.

In class B, let us assume that there are no horizontal slips and that the ore stands well. Back-stoping may go on much less carefully. Any number of circular cuts can be made in the stope and machines work away from these points in circles; or the first two schemes given may be used. The stoper drill may be advantageously used drilling up into the overhanging ground. The drill runner, however, need not always stand directly under the overhang, though his machine may be working there.

The barring or "scaling" down in mines worked by this method is another point of great importance. In cases where the back is bad, it is wise to have the stope boss carefully inspect the stope before permitting the men to enter. In some cases a man is kept barring down all the time, and if the mine is not worked on Sundays, an especially careful inspection is made on that day, extension ladders being used at inaccessible points.

One of the most baffling problems to solve satisfactorily is that of chute gates. In mines of this class large boulders or slabs render the simple arc gate or the common double-sliding boards unsatisfactory.

Finger gates are successfully used in some mines. A bulldozing chute was described in the Oct. 18, 1913, issue of the *Journal,* and a chute using pole lagging for a gate was also recently described therein. All these are to cope with the large boulder problem. Of the three, the finger chute seems the most complicated mechanically. The bulldozing chute described by G. J. Jackson is very ingenious and, though requiring a lot of headroom, time and work to construct, it has but little to get out of order. It would seem, however, that if ore passes were numerous the expense of such a gate would be rather high. The chute of pole lagging is simple and cheap, but when this is used, it is difficult to prevent rushes of ore into the drift after a boulder has passed through. There are other schemes for handling large boulders in chutes, but those mentioned appear to be the most successful.

The foregoing discussion leaves little place for the stoper drill. Piston machines have been used to put up raises, and in one mine at least they are used to put up the ore passes. Piston machines use larger steel, making fewer holes necessary, and they can put in deeper holes. This is not intended to discount the ability of the hammer drill, but in very hard ground—in which most of the foregoing observations were made—the much-lauded speed of the hammer drill does not obtain.

Possible Source of Potash

Following Secretary Lane's instructions to put special effort into its potash investigations, the Geological Survey is publishing the suggestion that a possible source of potash may exist in the tailings piled up at the concentrating mills of the big copper mines in the West. The "porphyry" ores which are being mined by the millions of tons annually contain several times as much potash as copper, and this remains in the tailings at the mills, material already finely ground and in condition for treatment, as well as easily accessible for shipment. This potash, however, is locked up in the form of silicate minerals, and the commercial extraction of potash from silicates has been for several years the subject of earnest study by industrial chemists. If this problem can be solved, it would appear that a large tonnage of potash-bearing material is available in the Western states.

A brief report by the Geological Survey (Bulletin 620-J) contains typical analyses of these "porphyry" ores from the largest copper camps in a half-dozen states, as well as tonnage estimates of the ore reserves and ore already mined and treated. A few check analyses of tailings are also published.

Suggestion of a possible potash reserve in these tailings originated with B. S. Butler, the geologist in charge of the Survey's statistical study of copper, who has based this short paper upon the published analyses of specimens collected by the government geologists in their investigations of the mining districts.

The significant fact regarding this possible source of potash is that in quantity it is more than adequate to meet all the needs of the country as measured by presen consumption.

Plucking the Goose as Town Policy

To the average onlooker, who associates the terms "taxation and representation" somewhat vaguely with the Boston tea party and lets it go at that, there was nothing about the Harrison bill, recently defeated by a determined filibuster in the Minnesota Legislature, to catch his attention or warrant the fight it raised, says *The Survey,* Oct. 16, 1915. It is proposed to restrict tax levies for municipal purposes (exclusive of the support of schools) in towns of the third and fourth class, to $25 per capita. The average per capita rate throughout the state is about one-fifth of that amount.

In the background is a story of absentee ownership with a new problem on its hands, of charges and countercharges of looting and oppression, in which the United States Steel Corporation and other mine owners appear as plaintiffs, and five towns on the Mesabi Iron Range in Minnesota play the rôle of hold-up men, of specialists in town improvement or of thrifty taxpayers holding rich corporations to proper account—all according to the point of view.

How Do Your Taxes Grow?

In 1914 the average per capita tax for local purposes in 140 Minnesota cities and villages was $5.35. In Duluth, St. Paul and Minneapolis, cities of the first class, the per capita taxes were $11.01, $11.20 and $12.52 respectively. The per capita tax in Hibbing was $85.35. Nor is Hibbing a millionaire colony. It is a mining village of some 10,000 population, the principal industry of which at present seems to be taxgathering.

During the past decade, the taxes have increased 27 times as fast as the population. And the story of Hibbing is in essentials the story also of Chisholm, Buhl, Keewatin and Mountain Iron.

The explanation is simple. The voters levy the taxes. The nonvoting mining corporations own about 98% of the taxable property. Somebody who wanted a new sidewalk or an extra town pump woke up to the possibilities of the situation. Soon the town pockets were bulging with gold, which seemed to burn the traditional holes in them. As the *Mesaba Ore,* of Hibbing, remarked editorially (Mar. 27):

We should not overlook the opportunity presented to us, and you'll notice we are not overlooking it.

While Hibbing took a leading part, it did not play the game alone. For some years the five towns carried on rival village-improvement bees enlivened by an exhibit of how much open-handed communities can spend when money comes easily.

Hibbing Installs a Great White Way

Before long, Hibbing had more street lights on its "Great White Way" than Cincinnati, a city of 400,000. Eight ornamental lamp-posts, each carrying five incandescent lights, now illumine the principal street intersections. It spent $374,000 for paving in 1914. Its payroll for that year was roughly, $446,000, which provided for a monthly average of 894 men, although there were but 1,318 voters at the last state election. The only state officers that received a larger yearly income last year than Hibbing's treasurer were the governor and the justices of the supreme court.

The expenditure, in a single year (1914) was $1,204,742. Only $620,434 of the warrants issued for this were met with cash, and the outstanding current indebtedness at the end of the year amounted to $1,252,597.

Chisholm, which had 733 voters at the last election, had a monthly average of 538 men on her payroll. An attempt at economy on the part of some of the more timorous members of the council was scathingly dealt with in the *Tribune-Herald* of Mar. 26 last:

> By its action Wednesday the Chisholm council put a crimp in the local baseball team, many of the men that had been given jobs all winter in an effort to keep them here for the coming season being laid off. This is in striking contrast to the action of the Hibbing council, which this year has imported men from the best leagues possible in order that the village of Hibbing might have a first-class ball team.

After a defeat by one of the other towns, the council sought to remedy the error referred to by voting $1,000 to the team.

When a municipal well was sunk in Keewatin, it was a ceremonious occasion. It took five inspectors and a superintendent to supervise the work, in addition to a city engineer. The tax levies had been high for years, but took spectacular jumps in 1913 and 1914. Hibbing's rose gradually from $60,985 in 1904 to $276,490 in 1912, to $753,800 in 1914, and $1,693,933 in 1915. The levy in Mountain Iron for 1913 was 435% greater than the year before.

There was apparently no malice behind these increases—only an awakening to good business opportunities long neglected. And when the mining companies found their protests unavailing and sought legislative protection by the introduction of the Harrison bill previously referred to, indignation rose high in the five towns.

A Sacred Duty to Put On All Possible Taxes

Their main contentions were that they had a perfect right to levy extraordinarily large taxes on the mines, because the mines were exhausting the ore beds and would soon leave the towns with practically no taxable property; second, that the bill was a special-privilege bill fostered by big corporations in the interest of Eastern capitalists to the detriment of local communities; and third, that the expenses of government in mining towns are necessarily higher than in ordinary towns. As the *Mesaba Ore* put it:

> The "Ore" believes that every cent possible should be collected from the mining companies while they are with us, to the end that we may retain unto ourselves a share of the wealth that, once removed, will never return. . . . We do not believe in waste or extravagance in municipal management or anywhere else, but we shall hold that the village of Hibbing should collect every year the one and one-half million dollars due it from the mining companies.

And on Mar. 27 the same paper charged the city councils of the iron range with being

> remiss in their duty to the people of these communities because they do not levy the full amount allowed by law and spend it every year, whether it be extravagance or not. We owe it to ourselves to collect every cent available from the taxation of these mines and use it to beautify our towns because it belongs to us. Hibbing surely receives no thanks for handing over a million dollars a year of its own money to Eastern mine owners, and we will be just as well treated if we collect and spend all that is due us.

The mining companies in reply maintained that the ore deposits will not be exhausted for a long time to come, and such feverish taxation is therefore unnecessary; that if it were true that the ore would soon be exhausted, that fact in itself would be the best kind of a reason why the towns should not expend such vast sums in public improvements, because as soon as the mines were closed most of the population would leave the villages and there would be no one to enjoy the extensive public improvements provided.

The Harrison bill passed the Senate by a vote of 41 to 7, but was defeated in the House by a filibuster which lasted four weeks, although the bill had the support of most of the towns on the eastern end of the range. As the Virginia *Daily Enterprise* of Apr. 12 said, severely:

> If the "Mesaba Ore" (Hibbing) is of the opinion that its town has any considerable portion of the range behind it in the fight on the Harrison per capita tax bill it is mistaken. It has not. Hibbing is now in the position of the small boy who ate all the pie at the party. It has the bellyache and scant sympathy from the erstwhile guests.

Late dispatches state that almost all the mining companies have refused to pay their assessed taxes in Hibbing and will fight collection in the courts.

Basic Principles of Mining Cost*

I shall be able to call your attention to only a few simple matters, the influence of which on the cost of mining is, however, frequently overlooked even by experienced engineers.

The total cost of operating a mine can be divided into at least three independent items—labor, power and supplies. It is important to make this classification for two reasons: First, because the three items do not enter in the same proportions into the cost of operation at all mines; and second, because the variation in the cost for one item, from place to place, may not be in the same ratio as for another of the three items.

Geographical Situation Greatly Influences Costs

In general, the cost of mining in a given locality will vary with the expense and facilities for obtaining labor, power and supplies. Of all the mining regions in North America, I believe that the most favorably situated is found in western Pennsylvania. Between Pittsburgh and Lake Erie is a vast fertile country capable of supporting a large population; food is abundant, climate is excellent, and sociologic conditions are favorable. Hence labor is cheap and, what is of even greater advantage, can be carefully selected with a view to fitness. For power, the immense bituminous-coal fields and the areas yielding both oil and gas are close at hand. Finally, the district is surrounded and dotted with great manufacturing centers, whence mining supplies are available in great variety and at small expense of transportation.

When we seek to compare mining costs in so favorably situated a district with those prevailing in another part of the country—for example, Alaska or the desert parts of Nevada—strict allowance must be made for the changed environment. In both the localities just mentioned, and in many others as well, labor must be imported and it is not so easy to exercise discrimination in its selection. Furthermore, in a remote locality food is often poor and usually expensive and many of the ordinary comforts of civilized life, sometimes even the decencies, are wanting. These hardships must naturally be compensated in the form of higher wages. The cost of power is likewise gener-

*A lecture by J. R. Finlay before a class of mining-engineering students in the Columbia School of Mines, May 4, 1915, and published in the Columbia "School of Mines Quarterly" for April, 1915.

ally higher because of the expense for transportation of fuel. In some favored localities the supply of wood may suffice for a while, and in others hydro-electric power may be available, but the great majority of mines rely upon coal, and in many cases it will be found that the cost of transport exceeds that of mining. Thus coal which sells at Pittsburgh for, say, $1 per ton will cost $2.50 in the Lake Superior district, $4.50 in the Rocky Mountains and $7 or above in more remote districts. The same holds true of supplies, to the original price of which must be added cost of transportation by boat, rail, wagon or mule-back. Since steel and dynamite, the two most used materials, are relatively high-priced, the added cost of transportation is proportionately less than in the case of coal.

Situation Often Settles Payability

As a concrete example of the preceding remarks, let us compare a mine in southeast Missouri with one in Nevada, in both of which districts I have recently been so fortunate as to gain first-hand experience. In both cases we shall estimate that the output is at the rate of 4 tons per man per day. In southeast Missouri labor (at $2.60 per day) costs 65c. per ton of ore mined and milled; power (coal selling at $2.25 per ton) costs 25c. per ton of ore; and supplies cost 15c. per ton of ore; total, $1.05 per ton. Profit on this ore would then be about $1 per ton, out of which to deduct various general and interest charges. At a mine of the same character in Nevada, labor (at $4 per day) would cost $1; power (coal at $6.75 per ton), 75c.; supplies (estimated at 20% higher than in Missouri), 18c.; total, $1.93 per ton of ore, or $0.88 more than in Missouri. If the ore had the same market value, the profit would be only $0.12 as against $1, and this difference would very probably be the deciding factor in determining whether or not to begin operations in the more remote district. In short, the extreme variability of operating conditions at different mines and in different districts must never be overlooked.

It has been said that mining engineers do not know how to figure costs as a contractor would figure them. This is not exactly true, because all successful engineers really do know how to do it, and the wider their knowledge of operating factors the less liable they are to make mistakes. As a rule careless or ignorant computations result in underestimates. An excellent practice is for an engineer to put himself in the position of a contractor, personally responsible for a loss; cost estimates then cease to be academic questions.

Overhead Must Not Be Disregarded

The most fertile source of mistake in cost estimates is to assume that the data relating to a short period, possibly during a stage of most advantageous operation, are a true average over the whole life of an undertaking. It should be remembered that the cost of an enterprise includes everything that has to be done, from start to finish. To illustrate, suppose a shaft has to be sunk in New York City. If a practical miner were asked how much it would cost, he would first inquire how hard the rock is, and would then figure the cost merely as a job of rock breaking, at so many feet per shift. A contractor, on the other hand, would include in his estimate the necessity for installing hoists, compressors, shops and headgear, entailing maintenance, depreciation and interest on the cost of equipment during the whole period of operation.

In comparing one mine with another, the physical characters of the ore deposits are no less important than their geographical situations, a feature of the problem that is sometimes carelessly overlooked by those who ought to know better, and often purposely disguised by those who have some nefarious purpose in view. How often have we heard promoters calmly assert that a gold-bearing vein in Georgia, for example, could be mined at the same cost per ton as at the Homestake or the Alaska Treadwell?

The importance of careful comparison of geologic conditions was forcibly impressed upon me about three years ago when I had occasion to examine a silver mine in New Mexico, at which the cost of mining and milling was $8 per ton. The mine was controlled by residents of the Lake Superior district, who, reasoning from their immediate experience, thought that the cost ought to be reduced to $3 per ton and wished to be informed why not. The reason is that a silver lode in New Mexico is not like a bed of copper rock or a basin of hematite in the Lake Superior region, and cannot be mined in the same way. Actually, the Camp Bird mine, of Colorado, offers a much clearer analogy, in width of vein, character of mineralization and occurrence of oreshoots, the latter constituting only 25 to 30% of the whole vein and compelling a relatively great amount of exploration and development. The cost of Camp Bird is from $7 to $8 per ton. My Lake Superior friends failed to be impressed by my reasoning and proceeded to capitalize and equip their mine on the assumption of $3 costs; they are now sorry they did so.

While a careless reasoning from analogy may lead to disastrous failure, as in the case just noted, on the other hand, if geologic conditions and working environment at a new locality be reasonably similar to those at an older and established mine, this fact offers a quick and serviceable means of estimating the probable working cost at the mine about to be developed. In fact, a simple comparison, provided that all conditions are closely parallel or provided that allowance is made for divergent conditions, is much more useful and accurate than any amount of independent figuring.

Hamilton Smith's Rule a Wise One

In this connection, it is often possible to make use of certain formulas and standards of comparison that are not so well known as they deserve to be. Hamilton Smith, a distinguished engineer about 30 years ago, suggested the advantage of comparing mines on the basis of yield per unit of stoping area, and gave as his opinion that, with gold ore of good quality, no mine would be profitable which yielded less than $3 per sq.ft. of stoping area, equivalent to $130,000 per acre. Applying this formula recently to a fairly profitable gold mine in Nevada, having a vein 1 ft. thick, of ore averaging $40 per ton, I was interested to observe, allowing 13 cu.ft. per ton, that the yield of that mine was almost exactly $3 per square foot of stoping area. Actual stoping width was about 4 ft., and profits were about 20% of the gross yield.

Smith's factor is important to bear in mind, regardless of other estimates of cost obtained by calculation, comparison or otherwise, especially for checking overestimates of net profits. A mine alleged to yield net profits of 75% of the gross output should be approached cautiously, because such mines are very rare. The Goldfield Consolidated, for example, for considerable periods

yields at the rate of $20 per sq.ft. of the whole area of vein explored—not merely shoot or stoped area; yet the net profits of this mine for the past five years have averaged only 58% of the gross yield, under particularly competent management. On the whole, Smith's rule is a wise one to follow.

Cost Per Ton Often No Criterion

Some people are inclined to attach too much importance to cost per ton, as though this unit possessed some sacred functions. It may often happen that some other unit, as Smith's yield per unit of stoping area, is more serviceable and relevant. Cost per ton is merely the value of the work that has been done on that ton and may bear a very indefinite relation to the profitableness of the operation. As an extreme case, 1 ton of gold worth $600,000 might be mined for $450,000, or 75% of its value, yielding a profit of $150,000. A ton of silver worth $15,000 is mined at Cobalt for $6,000, or at $600 per ton of ore, assuming it to contain 10% silver; yet, rightly considered, this should not be called expensive mining. At Grass Valley, Calif., it costs about $5 to mine and mill 1 ton of ore; at the Michigan copper mines it costs only $1.25; yet applying Smith's unit, we find that the cost per acre of stoping area is nearly alike in these two places—$100,000 at Grass Valley and $70,000 to $120,000 in the copper country. In southeast Missouri the cost is almost exactly $100,000 per acre for mining and milling. We thus see that the really important factor is not how many tons are mined, but how much area must be excavated.

Type of Orebody Influences Cost

Finally, before making comparisons of cost it is important to note the relative difficulties arising from different positions of an orebody; it makes a great difference whether a deposit is horizontal, vertical or inclined. A horizontal deposit is always the cheapest to mine, because when the shaft is sunk there is only one level, one shaft, one pump station. A vertical deposit requires many levels, each exploited separately, each requiring a shaft station and sometimes an independent pump station. Inclined deposits, if not steep enough for broken ore to slide, involve all the disadvantages of a vertical vein, with the added expense of handling ore in stopes.

Your professors have of course discussed the engineering aspects of this matter; I intended only, in conclusion, to emphasize the importance of careful scrutiny before attempting a comparison of working costs.

Anaconda's Community Experiment

One year has elapsed since the Anaconda Copper Mining Co. completed its plan for providing farm homes for its employees. In that time 40 families have established themselves at "Opportunity," the new community six miles east of Anaconda. Eighty children are attending the new Beaver Dam school in Opportunity. Street-car service meeting all shifts has been established, and for a 5c. fare the employees are carried to and from the Washoe Reduction Works at Anaconda.

By way of review it might be mentioned that this enterprise is an outgrowth of the smoke litigation of some years ago. At that time the territory embraced in the new community was practically a swamp. Profitable agriculture was impossible owing to increased wetness of these bottom lands from irrigation of higher lands. Originally the bottom of an old glacial lake, later a beaver-dam bottom where wild duck, muskrats and beaver made their homes, this land in its drier portions was supporting an indifferent agriculture where wire grass and slough grass were the principal crops and the prosecution of smoke claims the main occupation of the landholders.

WHEAT—FIRST CROP AFTER RECLAMATION—1915

BARLEY—FIRST CROP AFTER RECLAMATION—1915

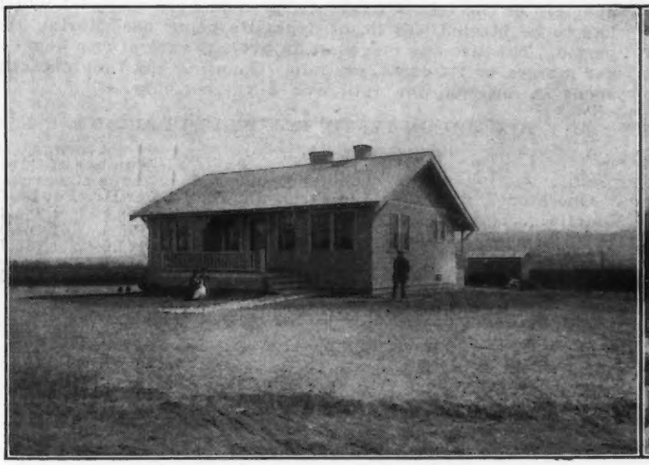
No place in America in the same length of time has had a more revolutionary change take place than that which has been effected in this community—swamp and slough have been replaced by garden and grain field. Land that was so boggy that portions were fenced to prevent loss of livestock from miring is traversed daily by street cars and automobiles, while all over the area comfortable little homes are springing up, the nucleus of a better set of living conditions and a better citizenship.

About 4,000 acres of land has been reclaimed, of which 1,000 has been opened for settlement. This reclamation has been effected by tile drainage in which parallel lines of 12-in. tile have been placed 1,000 ft. apart along the line of greatest slope at a depth of 6 ft. The tough sod was then torn up with specially designed machinery, the peat burned off, and later plowed and disked with traction machinery. The land was laid off in tracts of from 5 to 10 acres, the majority being 10 acres. Every tract has a graded street in the front and an alley in the rear. The land is sold by direct purchase or on a bank-installment plan over a 30-month period and is turned over to the purchaser plowed and ready for crop. An irrigation system has been provided by which water is delivered at the owner's tract. The source of the

irrigation water is the creek flowing through the land, supplemented by the novel arrangement of pumping drainage water from sumps in the drain lines, the power line for pumping plants also supplies power for domestic lighting, pumping and cooking.

Reclaimed swamp land must of necessity be cropped for several years before becoming suitable to seed to permanent hay or meadow crops. The Farms Co., after the first tillage, plows, seeds and harvests the grain crops for the tract owners, charging them the actual cost of these operations. This obviates the necessity of landholders' owning tillage machinery and horses sufficient for the work, which would be impractical on such small areas. As an aid to their building operations, the lumber department of the company provides lumber at cost plus a small handling charge, and several carloads of lumber are kept in stock on the ground.

Many owners whose means are limited have built temporary houses which will be converted into barns or chicken houses when more costly homes can be afforded. In this connection the company has made arrangements whereby land purchasers having their tracts paid for can secure a liberal loan on easy terms to help with their building operations.



RESIDENCE AT OPPORTUNITY

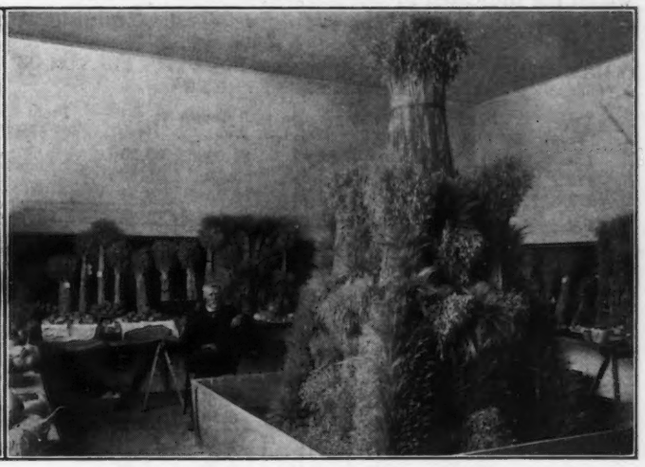


EXHIBIT AT THE OPPORTUNITY FAIR

Plans looking toward the development of the interest both of the parents and children in their homes and the enterprise are being worked out. A most successful agricultural exhibit and fair was held by Opportunity residents in the school building Oct. 9 and 10. The interest shown by the children was an inspiration and the exhibits a revelation even to the company officers who had shared in this development. Despite a heavy snow and rain, between 500 and 600 persons came to the little fair on Oct. 10. Next year greater things are promised—a school-garden competition for the children, a pig club and a sheep club and a bigger "Opportunity" fair. This year one tract owner showed 23 kinds of vegetables. Cows, pigs, chickens, turkeys, duck, geese and rabbits were shown. The best part of the fair, however, was the interest shown by the children.

Centrally located in the enterprise is a 65-acre park through which a clear, wooded mountain stream flows. The schoolhouse is in the park and the Anaconda Country Club is now building a clubhouse on a tract adjacent to the park, and a golf course has already been laid out.

With the Forty-Niners

The historically important discovery of gold in California was made in January, 1848, at John Sutter's mill on the South Fork of the American River near Coloma, a point only 10 or 15 mi. southeast of the town of Auburn. From 1850 to 1853 the greatest yield was derived from the gravels, and the largest annual output for this period was more than $65,000,000, in 1852. There was some reaction in 1854, due to previous wild speculation, but a production of about $50,000,000 a year, chiefly from placer mines, was maintained up to 1861, according to the United States Geological Survey.

At first the gold was won chiefly from the gravels along the present streams. Those who first got possession of the rich bars on American, Yuba, Feather, and Stanislaus Rivers and some of the smaller streams in the heart of the gold region made at times from $1,000 to $5,000 a day. In 1848 $500 to $700 a day was not unusual luck; but on the other hand, the income of the great majority of miners was far less than that of men who seriously devoted themselves to trade or even to common labor.

The gold pan, the "rocker," the "tom," the sluice, and the hydraulic "giant" or "monitor," named in the order of increasing efficiency, were the tools successively used by the miners. Into the "rocker" and the "tom" the miner shoveled gravel or "dirt," rocking the machine as he poured in water and catching the gold, often with the aid of quicksilver, on riffles set across the bottom of his box. Sometimes a stream was diverted into a flume to lay bare the gravel in its bed so that the miner could get at it. In sluicing, the gravel was shoveled into a similar but much longer box, through which a stream of water was allowed to run. The hydraulic giant was employed to wash into long riffle-set sluices immense quantities of gravel, especially from the higher (Tertiary) deposits, much of which was too lean to work out by hand. Water was brought for many miles in ditches and flumes from the high Sierra and conducted under great head to a nozzle, from which it was projected with tremendous force against the gravel. It was the vast quantity of refuse washed into the streams by these hydraulic operations that brought about the conflict between mining and agricultural interests finally decided in favor of the farmers.

Details of Practical Mining

Table Showing Minimum Grade of Copper Ore and Profits

By Frederick W. Foote

The accompanying table has been found useful in determining the lowest-grade copper ore that can be mined at a profit at any property. If the property is a copper producer only, the total cost of mining, milling, smelting, etc., is plotted on the table as a "deadline" above which no profit can be made. Of course lower grades can be mined with higher prices of copper. This causes the line to be jagged. Below the deadline, successive lines are drawn showing the range of percentages and prices in which the indicated profits are made. If any gold or silver is present, its value is taken from the cost of mining, so

TABLE GIVING PERCENTAGE OF COPPER AND VALUE PER TON OF ORE AT DIFFERENT PRICES *

Cu, %	Lb. per Ton	Value per Ton with Copper at 13c.	14c.	15c.	16c.	Profit per Ton
1.0	20	$2.60	$2.80	$3.00	$3.20	
1.1	22	2.86	3.08	3.30	3.52	
1.2	24	3.12	3.36	3.60	3.84	
1.3	26	3.38	3.64	3.90	4.16	
1.4	28	3.64	3.92	4.20	4.48	
1.5	30	3.90	4.20	4.50	4.80	$0.50
1.6	32	4.16	4.48	4.80	5.12	1.00
1.7	34	4.22	4.76	5.10	5.38	
1.8	36	4.68	5.04	5.40	5.76	1.50
1.9	38	4.94	5.32	5.70	6.08	2.00
2.0	40	5.20	5.60	6.00	6.40	
2.1	42	5.46	5.88	6.30	6.72	2.50
2.2	44	5.72	6.16	6.60	7.04	3.00
2.3	46	5.98	6.44	6.90	7.36	
2.4	48	6.24	6.72	7.20	7.68	
2.5	50	6.50	7.00	7.50	8.00	3.50
2.6	52	6.76	7.28	7.80	8.32	4.00
2.7	54	7.02	7.56	8.10	8.64	etc.
2.8	56	7.28	7.84	8.40	8.96	
2.9	58	7.54	8.12	8.70	9.28	
3.0	60	7.80	8.40	9.00	9.60	
4.0	80	10.40	11.20	12.00	12.80	
5.0	100	13.00	14.00	15.00	16.00	
6.0	120	15.60	16.80	18.00	19.20	
7.0	140	18.20	19.60	21.00	22.40	
8.0	160	20.80	22.40	24.00	25.60	
9.0	180	23.40	25.20	27.00	28.80	
10.0	200	26.00	28.00	30.00	32.00	

* Deadline with assumed production cost of $4 per ton of ore.

that the deadline is raised an amount equal to the aggregate value of the gold and silver. The table given covers the usual range of percentages and prices, but a table of this type can be made to suit the individual requirements of any mine. If preferred, the gold and silver credits can be shown separately, but it seems to me to be simpler to conceive of these credits as being applied to the cost of mining rather than to the ultimate profit.

In a particular case the cost of mining, etc., was $4 per ton. This caused the deadline to be as shown by the double line. If, for instance, $2.50 profit be required per ton and copper is at 15c., then coming along inside of the 2.50 block to the nearest approximation of desired value and going horizontally to the left, it is seen that 2.2% is the minimum ore minable.

An Electric Dragline Excavates 60,000 Yd. in 18 Days

Fast work was done by the operators of a 1¼-yd. electric dragline excavator on the drainage work of the Boise project, under way by the Reclamation Service. The *Reclamation Record* for October publishes the following data furnished by J. L. Burkholder, assistant engineer:

The machine was operated from noon on Aug. 14 continuously to the end of the month, and approximately three-quarters of the length excavated was in hard material which had to be blasted, 600 lb. of dynamite being used during the period. The dirt was moved at an average rate of two buckets per minute, or 2.3 cu.yd. per min. Counting the time actually spent in digging, the rate was 3 yd. per min.

RECORD ON 1¼-YD. ELECTRIC DRAGLINE

Operator	Amount Excavated Lin.Ft.	Amount Excavated Cu.Yd.	Average Number of Cubic Yards Excavated Per Hr.	Average Number of Cubic Yards Excavated Per Shift
Martin	3,150	22,617.5	185.8	1,256.5
Gibson	2,680	19,787.7	175.9	1,164.0
Wirth	2,080	16,184.3	173.6	1,135.7
Total and average..	7,910	58,589.5	178.9	1,189.6

MACHINE EFFICIENCY

	Hr.	Per Cent.
Digging	327:30	77.2
Mechanical repairs	58:30	13.8
Electrical repairs	24:30	5.8
Moving	12:45	3.0
Blasting	0:45	0.2
Total	424:00	100.0

There were 49¼ shifts. The record run per shift was 1,583 cu.yd.

The Use and Abuse of Fuse

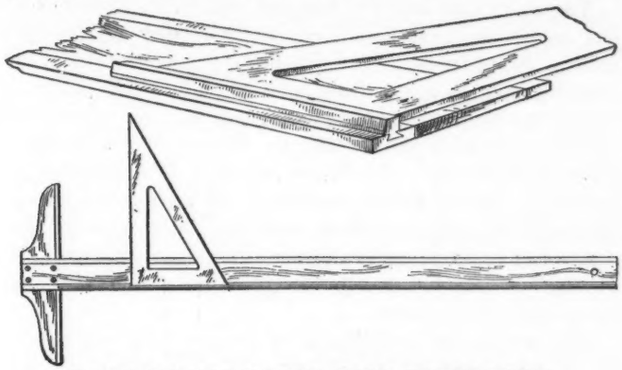
Many miners, acting in good faith but through a misconception of the waterproofing quality of axle grease or crude oil when applied to the outside of a capped fuse so as to make a so-called waterproof joint, start trouble for themselves. Grease and oil are solvents of the fuse varnishes, and when they penetrate the outer covering they destroy the powder train in the fuse with as great, if not greater, rapidity than would the water that the miner is trying to exclude.

When preparing fuse for use, it is common practice to coil it around the arm like coiling up a clothesline. This is bad practice because kinks are liable to occur to break the powder train. When cutting off the fuse care should be exercised to cut square across and not obliquely, which will leave a sharp point at the end of a fuse—not a particularly safe thing to jab into a blasting cap. Furthermore, if the point happens to be soft, as it is likely to be in warm weather, it will bend over or curl up and is liable to cause a misfire. Misfires are more likely to be due to lack of care on the part of the miner making up the primers than to fault in the fuse itself.

When making up primers, do not hesitate to cut an inch of fuse from the end of the coil. In doing this the damp ends will be prevented from getting into the detonating cap. Fuse that has been hammered or injured by falling ground, or damaged from any other source, should never be used. Any change in the covering of the fuse will either increase the burning rate or have the opposite effect and cause a misfire.

T-Square for Inking Over Fresh Lines

A T-square with three working edges on the bar has recently been patented by E. R. Ruehle & Co., 119 Fulton St., New York City. The third edge is furnished by a stop along the bar. By means of this addition the draftsman's triangle can be slid along the board, but held clear of the tracing, so that additional ink lines can be placed on a drawing without waiting for any fresh lines beneath to dry.



T-SQUARE FOR INKING OVER FRESH LINES

Diameter of Sheaves for Hoisting Rope*

The figures take care of the variables of depth of shaft, hoisting speed and acceleration stresses. The question of bending stresses is not considered. The bending stress of course increases as the diameter of the sheave or drum decreases. It could be kept from becoming too great by specifying minimum permissible ratios between sheave and rope diameters. The increase in stress caused by running a rope over too small a sheave is unimportant compared with the resulting increase in rope wear, and considerations of economy can be trusted to prevent the use of sheaves and drums too small for the ropes.

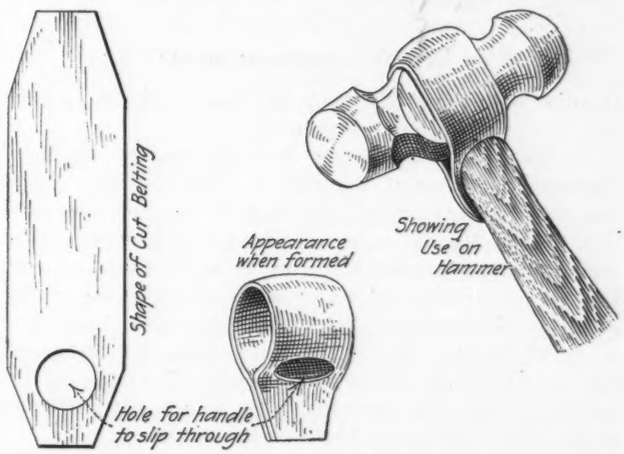
The economical ratio between rope and sheave diameters varies with the character of the wire in the rope and the type of construction. A pliable rope can run economically and safely over a smaller sheave than can a stiffer rope. The committee has reports of excellent results from the use of a 1¼-in. rope over an 84-in. sheave, which gives a ratio of 66, whereas in many cases, especially in the case of deep shafts and long ropes which usually are of necessity stiffer, a ratio of 100 has been recognized as not too high.

In connection with the question of sheave diameters, one point should be noted, namely, that it is possible to make the ratio too high under certain conditions, or more correctly stated, it is possible to make the sheave too heavy. This is the case frequently with turn-sheaves, guide pulleys, rollers, etc., on which the arc of contact and the compression between sheave and rope may be so little as to allow excessive slip, the rope failing to rotate the sheave easily. Of course such a condition would cause wear and tend to deteriorate the rope faster than would the use of a smaller, lighter sheave. To decide on a suitable size of sheave under such conditions the following rule is serviceable: Suppose that a ratio between sheave and rope diameters of 72 is considered permissible. Then when the deflection angle of the rope is less than 90°, that is, when it has less than 90° of contact arc on the sheave, the diameter of the sheave shall be eight-tenths of the deflection angle times the diameter of the rope. Thus as the deflection angle or arc of contact becomes less, the size of the sheave decreases. For a 45°-deflection angle a 3-ft. sheave is required for a 1-in. rope, and for zero degree no sheave is required, a rubbing board alone being sufficient.

*Abstract from "Rules and Regulations for Metal Mines," by Ingalls, Douglas, Finlay, Channing and Hammond; Bulletin 75, United States Geological Survey.

A Handy Soft Hammer*

A way in which to make an ordinary engineer's hammer serve in place of a mallet or wooden hammer for use on wood or other soft materials consists in using a piece of leather or belting in the manner shown in the drawing. A hole is cut in the leather large enough to be slipped over the handle of the hammer and then brought to the head of the hammer. The flap is then brought over the head of the hammer and nailed on to the handle, or the two ends are wrapped to the handle with several turns of fine wire. The hammer is used sidewise on wood, which brings the leather belting into play and softens the blow. In this way the user has a hammer ready for various uses in a very compact and convenient form. The leather will wear for a remarkably long time.



ENGINEER'S HAMMER WITH LEATHER CUSHIONING

P. & B. Paint for Spitting Fuses

Many expedients are resorted to in order to insure the ignition of the powder train in fuse. Splitting the end of the fuse and inserting a pinch of dynamite or powder or a piece of candle wicking, and securing a stub of a candle to the end are schemes familiar to most miners, but

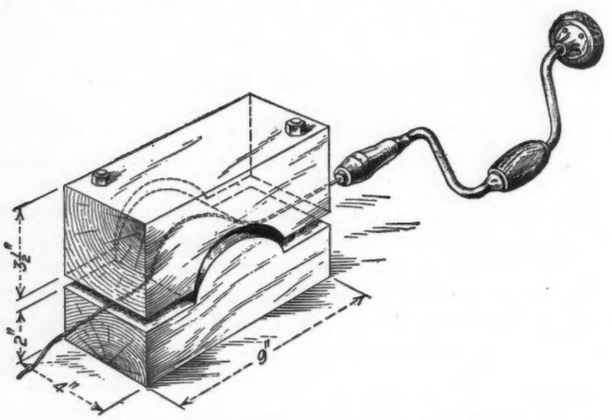
*A. P. Connor, Washington, D. C., in "American Machinist."

perhaps one of the best methods is that in use at the United Verde mines at Jerome, Ariz.

There the fuses, after being cut to the desired length, are dipped into P. & B. paint; one end only. The bunches of fuses are then laid up to allow the paint to harden. On application of a flame the ignition of the paint is instantaneous and is sure to fire the powder train. The paint will not drop off, as so frequently happens when using other attached means to fire the fuse, and the method has still another advantage in that the paint is waterproof and effectually guards the powder train from moisture, from the time the fuse is cut until it is set afire.

A Handy Wire Straightener*

One is sometimes confronted with the apparently hopeless task of straightening an old, crooked, kinked wire. To many this is no easy job, but to those that become



WIRE STRAIGHTENER IN OPERATION

familiar with the straightener here described the problem will be a comparatively simple one.

To make this straightener first procure two blocks of hardwood, each about 3½x4x9 in. Cut the two ends of one piece down from 3½ in. to 2 in. in thickness for a distance of 2½ in. from each end. This will leave a rectangular projection in the center of the piece. Round the two ends of this projection off as shown in the accompanying illustration. Now from the other block and on a 4x9-in. face cut out a concave depression to fit over the curved surface of the other block. Now, placing the two blocks together, bore two holes, one in each end and in opposite corners, as shown in the diagram.

By means of two bolts clamp the two blocks onto the wire to be straightened, near one end. Fastening a brace or something similar to the short end, turn the wire, drawing it through the block at the same time. The result will be a straight wire. This device will straighten a wire of any diameter.

Utilization of Peat Powder†

If peat that has been taken from the bog and allowed to disintegrate by lying on the surface of the bog during the winter be gathered, dried artificially and pulverized, a dark-colored nonabsorbent powder will result. The name "peat powder" has been applied to this product. It may be used in very much the same way that sawdust and powdered coal have been used.

When this powder is burned in specially constructed burners using a blast of air, it acts very much like a gas, on account of the intimate mixture that may be obtained, of powdered peat and air. The air supply can be regulated so as to approach that theoretically required for perfect combustion, and complete smokeless combustion results. The temperature of the flame is easily regulated, and temperatures sufficiently great for melting brass, iron and steel, and for other metallurgical operations, can be obtained.

Feeding Mine Animals

The one thing about a mine of which the superintendent knows less than any other is the proper care of livestock. Sometimes the entire mining proposition is dependent upon this livestock, and in many cases where no such vital importance attaches, great inconveniences and unusual expenses are caused by failure of the stock at some critical time. Furthermore, stock is expensive and forage is almost always unusually so in mining camps. Wasteful feeding is almost universal because it is generally left to some mule-skinner, who, if he has any idea of stock at all, has a very exaggerated idea of his own knowledge of the same.

The proper daily allowance of forage for a horse is 12 lb. of grain and 14 lb. of hay. If a horse weighs over 1,300 lb., however, he should be fed 14 lb. of grain and 17 lb. of hay per day. For a mule 9 lb. of grain and 14 lb. of hay should be allowed.

These allowances are prescribed for United States Army animals, but it is not deemed necessary to feed all animals the full allowance of grain. Each animal should be watched while eating and should be fed accordingly, except that the full allowance of hay should always be fed; if it is of good quality and the animal is in good condition, it will always be eaten. Grain should never be fed to animals when they are tired, hot or excited. If an animal continually fails to eat all of his allowance of grain, it should be cut down unless he shows signs of losing flesh; in that case he should be carefully watched and his mouth examined for lampas, and if he is found to be suffering from that cause, his grain should be soaked in warm water until soft. When changing grain, as from oats to barley or corn, cut down the portion of forage allowance, returning gradually to full feed in about five days. During this period more hay should be fed.

All animals need salt. The Army allowance provides for 2 oz. per week per animal, which is sufficient to allow a handful to each animal every 10 days. It is better, however, to feed salt a certain day each week.

Grain should always be fed before feeding hay. A mule will eat musty grain and hay, but a horse will not, and care should be exercised not to feed musty forage to either.

Mules give an indication that they are very tired when they fail to flap their ears while pulling a load. It may be relied upon that mules pulling a load and constantly flopping their ears, are in good condition.

Proper grooming of the animals every day will do much to keep them in condition and increase their pulling capacity.

*W. C. Eyl, University of Kentucky, Lexington, Ky., in "Coal Age," Nov. 6, 1915.

†Excerpts from Bulletin 45, "Peat Resources of Wisconsin," Wisconsin Geological and Natural History Survey, Madison, Wis., 1915.

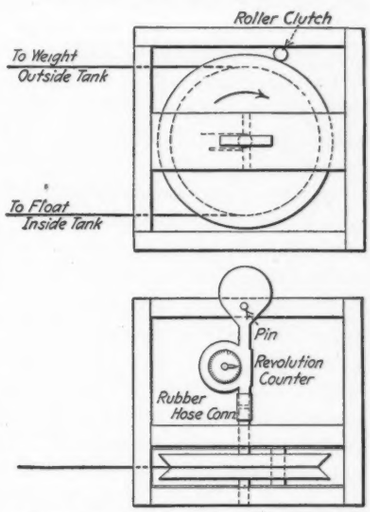
Details of Milling and Smelting

The Shapley Solution Meter

By Cooper Shapley*

In zinc-dust precipitation it is customary to use two gold sump tanks, one filling while the other is discharging. For measuring solutions under these conditions a meter must be used on each tank. The accompanying drawing shows one that is easy to make and has advantages of simplicity and accuracy.

Over the grooved wheel passes a light cord (fishline) to which a float is attached at one end and a light weight at the other. To the axle of this wheel is attached a revolution counter which registers the number of turns. The grooved wheel can move only in the direction of the arrow because of the roller clutch, which tends to wedge itself between the upright and the wheel when it tries to revolve in the reverse direction. When the solution in the tank is rising, the cord slips over the wheel and nothing is registered on the counter, but as soon as the level of the solution begins to fall, the wheel is turned in the direction of the arrow and the revolutions are registered. Each revolution represents so many tons of solution. It is an easy matter to calibrate the instrument, and as revolution counters usually register up to 5,000, it can be run for a month or several months at a time. In my case the wheel is 7½ in. in diameter and each revolution means 11.63 tons of solution. The float should be protected from ripples, since the slight up-and-down motion will cause the instrument to register too high.



SKETCH OF SOLUTION METER

Dolomite and Slag Furnace Lining

Owing to the present scarcity of magnesite brick, it may be of interest to some of the nonferrous metallurgists to try experimenting with a furnace lining recently patented by Albert P. Meyer (U. S. Pat. 1,160,085, assigned to the A. S. Davison Co., Pittsburgh, Penn.).

This consists of a uniform and intimate mixture of granules of basic slag and dolomitic lime, usually about 90 parts of lime and 10 parts of slag. Preferably a hard, compact, dense variety of dolomitic limestone should be used, and preferably those varieties high in magnesia. The limestone should be burnt to a degree sufficient to afford a sintered, clinkered or semi-fused mass, the material being thus prepared under conditions analogous to those of cement-clinker making, but with a higher finishing temperature; that is, around 2,800° F. The crude sintered granules of this lime are then mixed with granulated basic slag, in which state the material is either stored or shipped until wanted for use.

*Mining engineer, Buckhorn Mines Co., Buckhorn, Nev.

Effect of Sulphur Dioxide on Human Beings*

A careful consideration of all of the data concerning the occurrence of sulphur dioxide in the atmosphere in the Selby smoke zone and other places establishes the conclusion that the Selby smeltery, by the emission into the atmosphere of sulphur dioxide from its plant, does not maintain a nuisance in the southern portion of Solano County, California, as referred to an objectionable odor or disturbing physiological effects upon the mucous-membrane linings of the throat and lungs of human beings and domestic animals.

In order to determine the extent to which the invisible part of the Selby smoke may become a nuisance through the physiological effect its content of sulphur dioxide exerts upon man by disturbance of the normal functioning of the respiratory organs or disagreeably affecting the olfactory organs, the commission undertook an investigation to determine the sensitiveness of various persons to sulphur dioxide. It has already been shown that sulphur dioxide is the only gas discharged into the atmosphere through the stacks of the Selby smeltery that has an odor or can possibly be present in sufficient amount to produce any effect upon the throat and lungs when it is diluted by the air into which the smoke is discharged.

In the conduct of this investigation 60 subjects were experimented with. Some of them were observed through more than one experiment, so that a total of 85 experiments were recorded. Thirty-two of the subjects were persons thoroughly familiar with the odor and general characteristics of sulphur dioxide, and 28 were only sufficiently familiar with the gas to be able to identify it as "like sulphur matches when they burn," or by some similar method of comparison. Those thoroughly familiar with the gas were technically trained men or men that had worked in plants where sulphur dioxide is generated or is used; they were for the most part chemists, engineers and smelters. Those who were unfamiliar with the gas were the average intelligent citizens, sometimes capable of accurate description of the sensations they experienced under the tests and sometimes not; they knew the gas only as something that had a "sulphur smell."

Sulphur dioxide (SO_2) is a colorless gas of characteristic pungent odor and acid taste. It is 2.21 times as heavy as air, but mixes readily with it in all proportions

*Excerpt from "Report of the Selby Smelter Commission," Bull. 98, United States Bureau of Mines.

and once mixed does not, contrary to popular belief, again separate. In its concentrated form it produces marked physiological disturbances in all animal and vegetable organisms with which it comes in contact. It dissolves to a limited extent in water and has the property of combining with oxygen under proper conditions to form sulphur trioxide (SO_3). Sulphur trioxide combines very readily with water to form sulphuric acid.

Of those subjects who were acquainted with the gas and were trained to observe and report their observations correctly, none could detect the presence of the gas when it was breathed in concentrations of one part SO_2 per million parts of air. When the concentration reached two parts SO_2 per million, 13 of these subjects suspected the presence of something foreign in the air being breathed, but could not identify the substance, while two of the 32 thought they could identify the presence of the gas by their sense of taste, although they could not smell it. With three parts SO_2 per million in the atmosphere they were breathing, 26 of the subjects identified an acid gas as being present and six could detect nothing other than a foreign substance in the atmosphere. Of the 26 who could detect an acid gas, 21 identified it with more or less positiveness as sulphur dioxide, while five were doubtful of its identity. At four parts SO_2 per million parts of air, all but two of the 32 subjects were able to detect and positively identify the gas as sulphur dioxide. The two exceptions were men who had become more or less immune to the action of the gas from working in smelteries where the concentration is at times very high. At five parts SO_2 per million parts of air, all subjects but one, who was especially insensitive, were able to detect the gas. At eight parts SO_2 per million, all subjects except the same one could identify the gas as sulphur dioxide.

This would seem to indicate that persons who are thoroughly acquainted with the properties of sulphur dioxide, through study of, or experience with, the gas itself, can usually detect its presence in the atmosphere and identify the gas either by the sense of taste or smell when its concentration is about four parts per million or more. Approximately three-fourths of such persons are able to detect and identify the gas when its concentration is three parts per million, while about 40 per cent. are conscious that a foreign substance is in the atmosphere when the concentration is two parts SO_2 per million or more. In concentrations of less than two parts SO_2 per million, even persons thoroughly familiar with the properties of sulphur dioxide are unable to detect the presence of any foreign substance either by the sense of smell or the sense of taste.

Of those subjects who were unacquainted with the properties of sulphur dioxide, none could detect anything in an atmosphere containing one part SO_2 per million parts of air. This agrees with the observations of the "trained" subjects. At a concentration of two parts SO_2 per million, two of these persons detected a foreign smell in the atmosphere they were breathing but could not describe it. With three parts SO_2 per million, four subjects "smelled something" and six smelled "burning sulphur," while 18 "didn't smell anything." When the atmosphere contained four parts SO_2 per million, 10 of the "untrained" subjects smelled "burning sulphur," four "smelled something," and 14 did not note any sensation different from that experienced in breathing the ordinary air. With a concentration of five parts SO_2 per million, all of the "untrained" subjects except six "smelled something" or "smelled burning sulphur." At 12 parts SO_2 per million, all of the subjects could identify the gas as that of burning sulphur.

This would seem to indicate that the average citizen, not technically trained, can usually detect the presence of sulphur dioxide in the atmosphere and can identify it either by sense of taste or smell when its concentration is five parts SO_2 per million parts of air or more. One-half of such persons are able to detect the presence of the gas and some of them can identify it, when the atmosphere contains four parts SO_2 per million. When the atmosphere contains three parts SO_2 per million, 65 per cent. of the average citizens fail to record any unusual sensations when breathing it, whereas only 217 persons in every thousand would experience the feeling of breathing an atmosphere contaminated with "smell of burning sulphur." When the concentration is two parts SO_2 per million, only the most sensitive, 71 in every thousand, can detect a foreign odor; and below that concentration none can detect any foreign odor whatever.

Consideration of the data from all points of view indicates that a proper conclusion will be drawn from this investigation if it is stated that the average citizen is conscious of pollution of the atmosphere by sulphur dioxide when its concentration is approximately 3.5 parts per million parts of air; and the "trained" person is conscious of such pollution when the concentration is approximately 2.5 parts SO_2 per million parts of air.

In order to positively establish the minimum concentration of sulphur dioxide that would be considered a nuisance to all persons, it would be necessary to experiment with a much larger number of subjects. The time at the disposal of the commission did not permit of this. It was found as a result of the work done in this direction that the elements of psychology and personal idiosyncrasy entered into the matter to a great extent. The symptoms recorded by the various subjects, both "trained" and "untrained," were very dissimilar. No agreement was found between the ideas expressed as to what concentration was a nuisance. Without exception, however, all subjects considered that the point of concentration at which they could just detect a foreign substance or at which they were just conscious that there was something foreign in the atmosphere, was not a nuisance.

The commission is of the opinion, therefore, that in order that the smoke from the Selby smeltery shall produce a nuisance in the smoke zone, sulphur dioxide must be discharged from the smeltery in such an amount that as the smoke blows over the smoke zone, the concentration of sulphur dioxide in the atmosphere of the smoke zone must be three parts per million or more. This figure is the mean of those recorded from the "trained" and "untrained" subjects and refers solely to a nuisance brought about by the presence of a disagreeable or offensive odor. The difference between trained and untrained observers in susceptibility to the gas is extremely interesting.

At the Mill of the Bunker Hill & Sullivan Mining and Concentrating Co., at Kellogg, Idaho, an Ottumwa box-car loader is used in an original way. The coarse jig concentrates are shipped in box cars, and it is found convenient to deliver them through a chute to the box-car loader, which expeditiously and satisfactorily loads them into the cars. The method is said to be very much quicker and cheaper than hand labor, and no fault is found with it.

Mining & Metallurgical Machinery

Sullivan Air-Feed Drifter

The Sullivan Machinery Co. is putting on the market an air-feed drifter that combines the advantages of the elimination of one man from the drilling crew, the introduction of hammer drills, the employment of a water jet, and the air feed, which eliminates the feed screw and shell of the old piston type.

The pneumatic feed mounting consists of a saddle on the outside end of a short arm attached at right angles to a piston rod 24 in. long. The rear end of this rod terminates in a piston that runs in a feed cylinder; the

SULLIVAN AIR-FEED DRIFTER AT WORK

combination being similar to that employed in reverse-feed stoping drills. The feed cylinder is clamped at any point desired in a hinged trunnion cradle that can be quickly loosened or tightened by means of one nut. The arm that supports the drill contains an air inlet with swivel elbow and a throttle valve by means of which air is admitted to both the drill and the pneumatic feed. This throttle has several definite positions, in each of which a different effect is secured. In one position of the throttle the drill and steel are carried forward against the rock by air admitted only through the rear end of the piston; in a second position the drill is started running; two other successive positions of the throttle bring the drill up to full speed; and in still another position air is exhausted from the rear of the feed cylinder and admitted to the front side of the piston head, thus carrying the drill and steel back out of the hole and away from their work. By simply turning the throttle the operator may thus throw the drill forward or back with perfect ease and in a remarkably short time. The advantages of such a device over the crank and feed-screw type are obvious. With this air feed, drill steel can be changed in as little as 30 sec., there being no chuck bolts to loosen and retighten, and steels of uniform length in sets are not necessary.

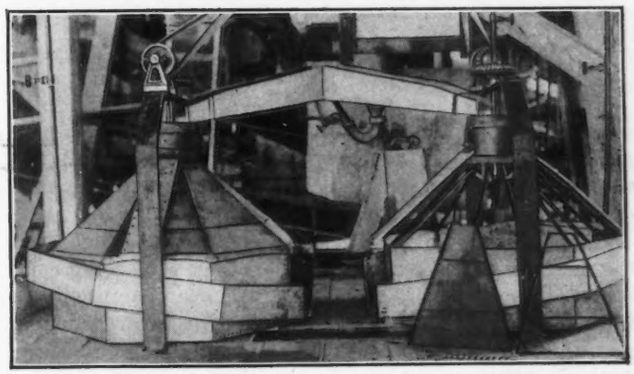
Should the drill steel show a tendency to stick while running, the operator, by setting a hand-brake on the throttle that throws on the reverse feed, can back the drill out of the difficulty with the hammer still running and the steel rotating. By simply turning the throttle valve, the drill may be made to alternately cut forward and retract itself, thus keeping the steel free and the hole round until the difficulty is passed.

With this drilling outfit, steels of a uniform length are not necessary.

The standard column for the air-feed drifter is 2½ in. in diameter, and arms can be used on this column up to 36 in. in length, so that it is entirely possible and practicable to drill a face 8 ft. high by 7 ft. wide, from one setting of the column.

The Wood Screening Machine

Machines for screen-sizing mill pulps have been in use for years, but the number of new ones that continue to appear indicates some difficulty in finding a perfect one. The device illustrated here is one designed to avoid, as far as possible, the inconveniences of the ordinary screening machines. It was designed by J. C. Wood, superintendent of the Hecla mill, near Wallace, Idaho, and is in use in that



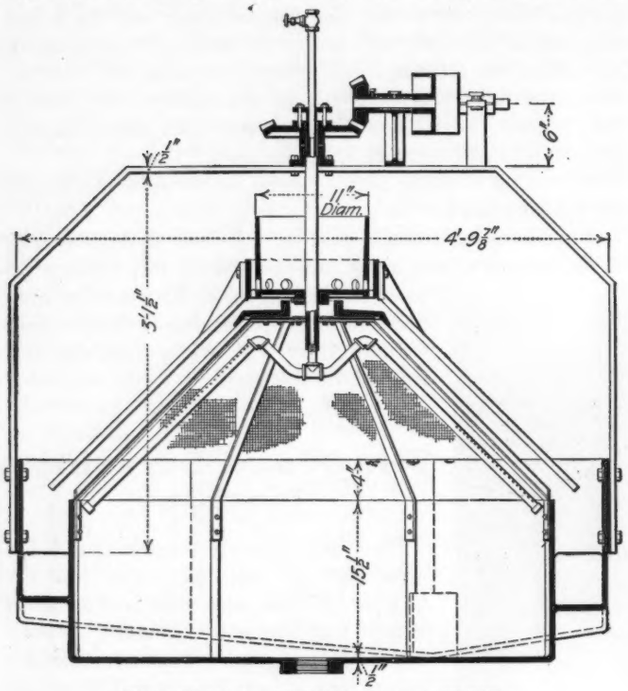
WOOD SCREENS, WITH FRAMES AND WITHOUT

plant. Mr. Wood has protected his machine by United States patent.

The Wood screen is in shape an octagonal cone, the eight sides of which are formed by steel frames carrying screen cloth of the desired mesh. Pulp for screening is delivered to the outside of the screens through an annular feeding box at the top of the machine, the undersize passing through the screen into a receptacle underneath, and the oversize sliding down over the screen surface into a launder at the base of the machine.

Revolving with the feeding box are two perforated pipes inside the screen, their function being to prevent blocking the screen apertures by delivering water under pressure against it. Outside the screen, directly opposite the perforated pipes and revolving with them, are two flat baffles, designed to avoid scattering or splashing the pulp.

The standard machine is made 4 ft. wide at the base and contains 24 sq.ft. of available screening surface. With



THE WOOD SCREENING MACHINE

16-mesh screen fitted to it, the machine is said to separate 80 tons of pulp per day of 24 hr., most of which is undersize. The accompanying drawing and photograph will give a clear idea of the construction of the device.

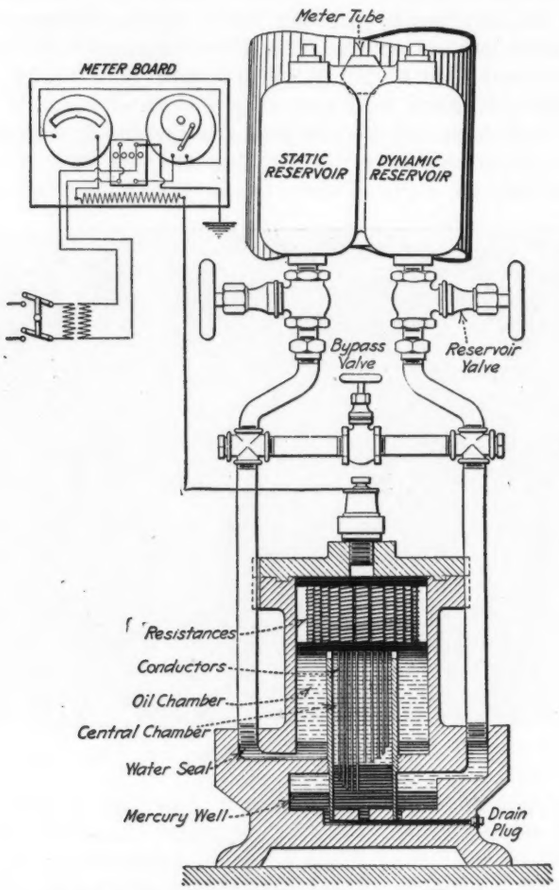
The Republic Flow Meter

The Republic flow meter has been developed recently to such an extent that in measuring steam, water, air or gas, it compares in accuracy and convenience with the standard wattmeter or ammeter. The principle is that of a U-tube containing mercury.

Contact wires of graded lengths are suspended over the mercury in the central chamber, each wire being connected to a resistance immediately above. A circuit is formed of the resistances, contact wires, mercury and ground, a current of given voltage usually 38 volts, being applied. All the resistances are in series with one another, and as the mercury rises as a result of the application of pressure on the surface of the mercury in the large chamber, a number of resistances are short-circuited. A definite quantity of current now flows through the circuit, actuating the indicating, recording or integrating instruments.

The resistances are of such magnitude that the quantity of current flowing at any time is a direct function of the velocity of the fluid flowing in the pipe, and therefore also of the quantity of fluid. The pointer of the indicating instrument moves equal distances for equal increments of velocity of flow.

The form of pitot tube used is a departure. It consists of two tubes extending completely across the pipe, impact holes being provided in one tube at the proper intervals. Each hole is located in the center of an annular ring, the cross-section of the pipe being divided into half as many equal-area annular rings as there are holes. The other tube is the aspiration tube and is identical with the impact tube. These tubes are placed back to back and are inserted in the pipe so that the impact holes will point upstream and the aspiration holes downstream. It has been found by actual experiment that



SECTION THROUGH REPUBLIC FLOW METER

this arrangement of impact holes results in the true mean of the velocities existing in the pipe.

The upstream side of the pitot tube is connected to the dynamic side of the mercury well, and the aspiration tube is connected to the other side of the mercury well. This results in the mercury being elevated in the central chamber to a height proportional to the square of the velocity of fluid in the pipe. The illustration shows that water is not permitted to touch the resistances or the contact wires, because of the oil seal.

A new feature is the micrometer adjustment for raising or lowering the resistance spool from the outside. In establishing the zero point the bypass valve is opened and the height of the contact wires is adjusted until the reading instruments show that no current is flowing.

Any combination of indicating, recording or integrating instruments may be connected to this meter. The Republic Flow Meters Co., of Chicago, is the maker.—*Power.*

Correspondence and Discussion

Concentration Formulas

I have read J. E. Clennell's short article under the heading, "Concentration Formulas," in the *Journal* of Oct. 30. In spite of the growing use of formulas I prefer simple arithmetic where it can be applied, as a formula, concealing its reactions, obscures the whole operation, however correct its results may be. This applies to mine-valuation formulas as well as those for metallurgical operations. The plain arithmetical solution, something on the line of blast-furnace balance sheets, which follows is preferable to the use of Clennell's formula. I respect his data and adopt his assumption that the assay value of the tailings and the concentrates will not be affected by clearing the middlings.

DATA OF CONCENTRATION TESTS

Product	Weight, per Cent.	Assay of Products per Ton, Gold, Oz.	Per Cent. of Total Gold
Concentrates	12.45	6.53	90.8
Middlings	11.45	0.35	4.5
Tailings	70.10	0.055	4.7

The head assay showed gold, 0.895 oz. per ton.

It is desired to find the effects of eliminating the middlings in this statement without actually performing the operation.

Let us assume that we have 100 tons of ore assaying 0.895 oz., which gives us 89.5 oz. of gold in the ore. In the concentrates we have $12.45 \times 6.53 = 81.29$ oz. The middlings will add to this $11.45 \times (0.35 - 0.055) = 3.37$, making a total extraction in concentrates of 84.66 oz. The percentage of extraction is $84.66 \div 89.5 = 94.6$. The former extraction in concentrates was 90.8%, making an increase of 3.8%, which will increase the weight of concentrates proportionately.

DATA ON CONCENTRATION AFTER ELIMINATING MIDDLINGS

	Weight, per Cent.	Per Cent. of Total Gold
Concentrates, 12.45×1.038 =	12.92	94.6
The tailings by difference =	87.08	5.4

Clennell's formulas require one addition, six subtractions, eight multiplications and five divisions. The plain arithmetical method requires only two additions, three subtractions, two multiplications and one division. Efficiency experts would therefore indorse the latter method, which has the added advantage of being clear and easily understood. LOUIS JANIN, JR.

San Francisco, Calif., Nov. 3, 1915.

Physical Control of Employees

The article in the *Journal* of Nov. 6, taken from the "Safety First Magazine" of the Nevada Consolidated Co., is somewhat misleading, in that it gives only one viewpoint. The company's orders of compulsory physical examination caused much dissatisfaction among its employees.

The age limit was placed at 44 years and the examination was so severe that one-half to two-thirds could not pass it satisfactorily. The employees felt that it was only a question of time when the older men and physical incompetents would be gradually weeded out. The company's physicians were unfeeling and arrogant, the men were made to strip, and the examination created much opposition and ill-feeling, the general public, without exception, being in sympathy with the men. The result was that finally the employees gave notice that unless these orders of compulsory physical examination were withdrawn, they would all walk out on Oct. 31, 1915. The company then withdrew the orders, evidently not desiring a strike with copper around 18c.

If this was generally adopted by all the large companies, the men and general public cannot see what would become of one-half or more of the laborers. Would the state take care of them? Is not a skilled workman a better man, past 40, than when 20 to 30 years old? Has he not better judgment, from experience? MINER.

Ely, Nev., Nov. 11, 1915.

Cost of Winter Construction

In the *Journal* of Oct. 2, H. Colin Campbell has taken exception to some of my recommendations under the heading, "Difficulties of Winter Construction."

Mr. Campbell's recommendations should be seriously considered where large masses of concrete are used, but they are hardly applicable to the class of work under consideration. On large concrete jobs of any kind conditions are more favorable than on the small one; they can be made so by virtue of size. The ultimate strength must be more nearly known in order to cut down the mass to a minimum. A smooth clean-cut surface might count for considerable, but in a small mill a little efflorescence is a matter of small moment. Heating the aggregate and mixing water would probably be the cheaper method with a large yardage of concrete, even at the expense of a special heating installation. The increased cost of concrete under these conditions would not reach 50%.

Unfavorable conditions, however, are the rule and not the exception for the average small mill constructed during the cold months in the north. Heavy snows and extreme cold weeather, being conceded, make the obtaining of material a difficult task. The average small mill that, as a rule, the operating engineer will be called upon to construct does not require a large yardage of concrete, and very often it is not an easy matter to arrange for heating. Midwinter construction is safe and feasible as long as the company will stand for the extra expense, which will often reach 50% in concrete work.

Trautwine and other authorities claim that freezing will not damage concrete after it obtains the preliminary set. I have never attempted to protect concrete after 12 hr. when the heating method is used and have never seen the least sign of failing, even in a mortar block, which is about as severe a test as can be found in a mill. Twelve hours is ample time to allow for the initial set with any good grade of portland cement. However, freezing may give an apparent hardness, and care should

be used not to remove the forms too quickly, or impose undue loads, which could easily produce failure when the concrete thaws out. The ultimate strength could hardly be materially reduced if proper care be taken. Freezing will retard the final set, but it is difficult to find a good reason for material damage after the hydration has taken place.

There appears to be a variance of opinion about the use of integral salts, but the consensus of opinion seems to be that the salts in themselves can cause no damage if not used to excess. This being so, why should their use damage the concrete if they keep it from freezing? The slow crystallization due to a low temperature might possibly lower the ultimate strength, but the reverse is true if poured in warm weather. Trautwine gives the following experiment, which goes to prove that concrete made of portland cement in cold weather and kept from freezing by the use of salt will not have a lesser ultimate strength, although concrete made of natural cement under the same conditions will have.

EFFECT OF COLD AND MIXING SALT WATER

Specimens; compressive strength of 12-in. cubes of portland- and natural-cement concrete: 8 cubes Atlas Portland, 1 cement: 3 gravel (2 sand, 1 pebbles): 4 crusher-run hard limestone; 8 cubes Louisville natural, 1 cement: 2 gravel: 3 stone. Same as used in track-elevation masonry by C., M. & St. P. Ry. Treatment: All cubes made by same person in molds of 1-in. lumber, and left in molds until broken. Results:

	Portland		Natural	
	Temp., °F.	Lb. per Sq.In.	Temp., °F.	Lb. per Sq.In.
Cube in warm office, 28 days..	80 to 18	1,290†	85 to 40	300
Cube in warm office, 28 days..	80 to 18	1,290†	85 to 40	Defective
Cube outdoors*, 28 days.....	57 to —24	902‡	57 to —10	200
Cube outdoors*, 28 days.....	57 to —24	690‡	57 to —10	256
Cube in office, 28 days.....	85 to 32	1,290†	85 to 40	352
Cube outdoors*§, 28 days....	57 to —24	1,290†	57 to —10	237
Cube outdoors*§, 28 days....	57 to —24	1,290†	57 to —10	247

* During first part of 28 days temperature fell to —10 and —20° F., afterward thawing during day and freezing at night.
† Flaked slightly.
‡ Cold believed to have retarded setting.
§ Mixed with salt water, 1 pt. salt to 10 qt. water.

Small quantities of concrete are often needed during the cold months around a mining property where heating is out of the question. I have had several occasions to use salts for such purpose; from all appearance the concrete was as firm as that put in during warm weather. It may have a lesser ultimate strength, but it is practical. The engineer with difficult winter work on hand is after practical results, namely, a sufficient factor of safety; he bothers his head very little about the surface appearance of a wall or foundation soon to be spotted over with slime, or about a few hundred pounds, difference in ultimate strength.

HARRY T. CURRAN.

Denver, Colo., Oct. 30, 1915.

Newfoundland's Mineral Resources

In the article on "Newfoundland's Mineral Resources" in the *Journal* of Oct. 23, Mr. McDonald failed to mention roofing slate. During the years 1901-04 the Newfoundland Slate Co. operated a quarry on Trinity Bay and produced a considerable quantity of high-grade purple and green roofing slate, which was sent to England and brought as high a price as the best Welsh slate. I understand that the reason for closing down the quarry was the death of the manager and moving spirit of the company and not the exhaustion of the deposit.

HORACE F. LUNT.

Colorado Springs, Colo., Nov. 15, 1915.

Timbering in New York Subway

In the *Journal* of Oct. 23 was published a letter of mine discussing Mr. Barbour's article on "Timbering in the New York Subway," which appeared in the *Journal* of Oct. 2. Following my letter was appended a criticism of it by Mr. Barbour, which shows a misconception of my statements. The object of my letter was to show that the principle of square-setting is not applicable to subway needs, because it depends on being wedged into place; while traffic vibration on the street structure and lack of abutments, including a light street structure, do not meet this requirement.

He says: "The statement that square-set timbering is not a self-contained structure applies only if one considers it in the nature of a house, which it is not. Square-set timbering underground is certainly self-contained when it is properly wedged in place, and it is not intended to be used any other way." I do not agree with this definition of square-setting. Underground it is not self-contained, but is wall-contained. In subway use it would be a house of cards, because of the impossibility of properly wedging it.

The next comment in the criticism is: "He also states that it is obvious that the use of continuous transverse members from side to side would be more secure than transverse members built up of short-length members tied together," and Mr. Barbour goes on to say: "Theoretically true, but 60-ft. cross-members, as would be required in the subway, are a scarce article, etc. . . . The only long cross-member used was one composed of two 24-in. I-beams at the ends, connected by two channels in the middle, and this construction as well as the entire framing of the bents, etc., . . . not only invited jack-knifing but got it."

The criticism has here confused the meaning of my statement by not fully quoting the paragraph. The full quotation states that square-setting could not be properly wedged in a subway cut, with the consequent necessity of tying and bracing and the disadvantage of short transverse members instead of long ones to better tie the structure together. I do not understand how this can be construed to mean that because the Broadway timbering had one long member in each bent I recommended the timbering. The structure jack-knifed because of no diagonal bracing between the bents, not because of the long member. It would have been the same or worse in this respect with cross-members built up of short lengths.

As to the comment about continuous cross-members being a scarce article, I did not refer to a single rolled I-beam or a single stick of timber, but to built-up continuous beams.

The last paragraph of my letter reads: "The best practice in subway timbering therefore includes continuous cross or transverse members to distribute loads, to brace the sides of the excavation and to tie the structure together more securely; the requisite rangers and lagging to hold the sides of the excavation; sufficient posting in all tiers and secure vertical diagonal bracing, both transversely and longitudinally, of all tiers of posts; sufficient struts or spacers and adequate street structure."

In the criticism only the first part of the foregoing paragraph is quoted, and the criticism states: "Inasmuch as the timbering in question did not brace the sides of the excavation which caved in and caused the fatal disaster,

I submit that the practice was not proper, even though it is considered the best practice in subway timbering."

On my part I submit that I made no statement whatever to the effect that the timbering of the accidents constituted the best practice; for if my whole definition on this point had been quoted, it can be readily seen that the timbering at the scenes of the accidents could not be construed as coming within the definition. It was lack of shoring that caused the rock slide, and lack of diagonal bracing caused the collapse of the street structures. JOHN SEWARD.

West Nutley, N. J., Oct. 30, 1915.

Roosevelt Tunnel Portal

My attention has been called to the fact that the pictures of the Roosevelt tunnel portal, published in the *Journal* of Oct. 2 and 23, do not seem consistent.

The one on page 683 of the issue of Oct. 23 was taken a few months after work was started. At that time I walked to the breast of the tunnel, about 200 ft. in, without getting my shoes muddy. The tunnel was dry until the main water course was cut, about 14,000 ft. from the portal. At the time the second picture was taken, recently, the water was about 2 ft. deep on the floor of the tunnel at the portal, but no work had been done there for years. As soon as the connection between the intermediate shaft and the tunnel was made, work was carried on through the shaft, and as soon as the El Paso shaft was sunk to the tunnel level the work was carried on through that shaft, which is the present practice.

Denver, Colo., Nov. 11, 1915. T. H. SHELDON.

Valuation of Ore Deposits

Misther Editor—'Tis interestin', the way some fellies figgers out the values av ore dayposits.

The other day Tim an' me was studyin' out the dope on wan av thim idle-rich mines in Arizony. Did ye iver notice how some av the idlest mines is bragged about as bein' the richest, jist like people?

Well, annyhow, there was a big bunch av maps, rayports, misfires an' John Hodgeses, certiffycuts, et cetery—enough paper to feed a dozen goats an' to indigest the wan they was intinded for—dished up by an imminent consultin' injineer with the assistance av siveral minin' injineers, assayers an' other boosters. Whin we got the stuff all b'iled down an' poured on the colander av pessimism, jist like Kathleen does with a bale av greens for dinner, we diskivered the follyin': (1) The old stopes was all caved in. (2) The shaft an' the drifts was timbered so tight that no wan cud luk at any walls or roof without pullin' things down like old Samson. (3) Ivery wan av thim injineers said he'd accept the figgers av the former superintendent (which was dead 12 year) on the assays av the samples taken whin the mine was bein' diviloped. (4) The only ividence av values was wan big chart av 479 assays taken on wan level, tellin' the number av inches av ore an' all that kind av thing.

It tuk Tim four days, not countin' three hours overtime, av multiplyin' inches, dollars, feet, assayers, et cetery; workin' like a full-grown rabit on all thim things he called facthors av numeraytor an' facthors av denominaytor. Whin he got through, the best raysult he cud get for the average value av all the ore was $11.47; while the big answer, han'somely engrossed at the bottom av the chart called for $27.63. So I sez to him, sez I, "Tim, now ye see what comes av playin' at bein' a defishency injineer whin the minin' business was dull. Have ye thried addin' up all the assay raysults an' dividin' by 479?"

"Why, Bill," sez Tim, "wud ye ignore complately all thim facthors av width av ore an' irregular intervals av samplin'? Ye're no injineer at all, at all."

"Sure, not," sez I, lightin' up me pipe again, "bein' only a prospector, like. But ye must raymimber that I sold a mine wance, mesilf."

Well, we figgered out the av'rage in the schoolboy way an' got the same as on the big chart; which was the wrong answer for a buyer.

Now, misther editor, do ye suppose the imminent consultin' injineer was to get fifty-fifty if the mine was sold?

Brooklyn, Oct. 26, 1915. BILL MCGINTY.

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

AGITATOR. Harry R. Conklin, Joplin, Mo. (U. S. No. 1,160,848; Nov. 16, 1915.)

ALLOYS—Apparatus for the Electrolytic Manufacture of Alloys of Light Metals with Heavier Metals and the Continuous Treatment of Such Alloys for Obtaining Final Products. Edgar Arthur Ashcroft, London, England. (U. S. No. 1,159,154; Nov. 2, 1915.)

AMALGAMATOR—Apparatus for Extracting Precious Metals. Victor I. Zachert, San Francisco, and Pierre A. Brangier, Agnew, Calif., assignors of one-third to Victor G. Bonaly, San Francisco, Cal. (U. S. No. 1,160,485; Nov. 16, 1915.)

CAR COUPLING—Automatic-Clench Car Coupling. William T. Lilly and Andrew J. Lilly, Glen Morgan, W. Va., assignors of one-half to Grover C. Hedrick, Beckley, W. Va. (U. S. No. 1,158,515; Nov. 2, 1915.)

CHARGING and Push-out Apparatus for Furnaces. William M. Neckerman, Youngstown, Ohio, assignor to The Youngstown Sheet and Tube Co., Youngstown, Ohio. (U. S. No. 1,159,702; Nov. 9, 1915.)

CORROSION—Method of Preventing the Rusting of Iron and Steel. Daniel F. Comstock, Brookline, Mass., assignor to Comstock & Wescott, Inc., Boston, Mass. (U. S. No. 1,159,748; Nov. 9, 1915.)

DRILLS—Drill-Steel-Turning Device for Percussive Fluid-Operated Drills. Caid H. Peck, Waverly, N. Y., assignor to Ingersoll-Rand Co., Jersey City, N. J. (U. S. No. 1,160,648; Nov. 16, 1915.)

CYANIDING—Extraction of Metals from Their Ores. Hugh M. Leslie, Glasgow, Scotland. (U. S. No. 1,158,514; Nov. 2, 1915.)

ELECTRIC FURNACE, Intended Chiefly for the Manufacture of Nitrides. Georges Coutagne, Lyon, France. (U. S. No. 1,158,899; Nov. 2, 1915.)

FLOTATION—Improvements in or Relating to the Separation of Metallic Sulphide Ores. Minerals Separation and De Bavays Processes, Ltd., Melbourne, Australia. (Brit. Nos. 19,273 of 1914 and 19,374 of 1914.)

GOLD-SAVING MACHINES. John T. Voigt, Richmond Beach, Wash. (U. S. No. 1,160,550; Nov. 16, 1915.)

JIG—Ore-jig. Frank Franz and Eugene R. Day, Wallace, Idaho. (U. S. No. 1,160,502; Nov. 16, 1915.)

LEACHING—Apparatus for Leaching Ores and the Like. Percy A. Robbins, Timmins, Ont. (U. S. No. 1,160,200; Nov. 16, 1915.)

LEAD ALLOYS—Hard Lead Alloys. Francis C. Frary, Minneapolis, and Sterling N. Temple, St. Paul, Minn.; said Temple assignor of one-sixth of the whole right to said Frary. (U. S. Nos. 1,158,671, 1,158,673, 1,158,674, and 1,158,675; Nov. 2, 1915.)

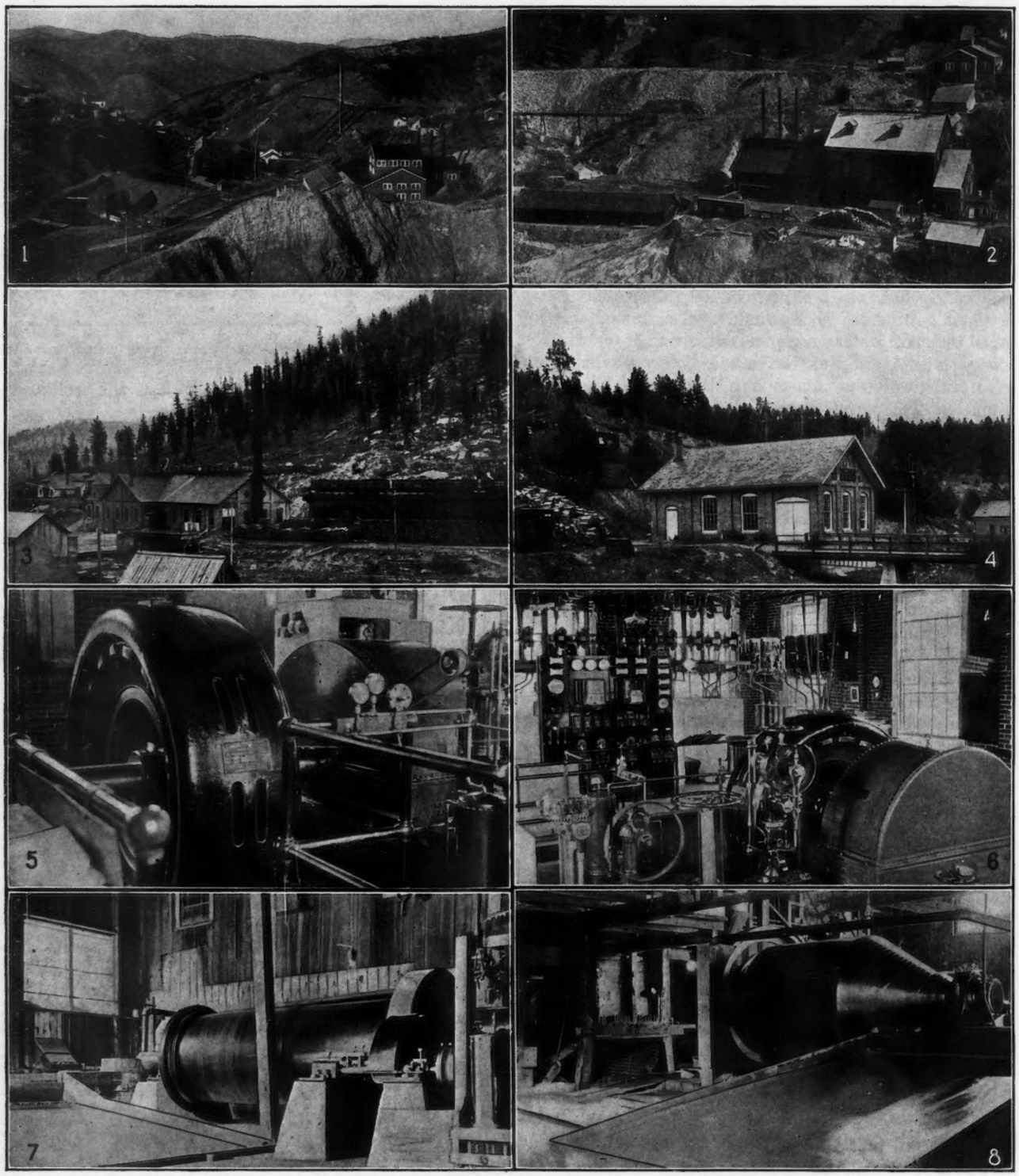
METAL COVERINGS—Method of Removing Metallic Coverings from Other Metals. Hans Foersterling and Herbert Philipp, Perth Amboy, N. J., assignors to The Roessler & Hasslacher Chemical Co., New York, N. Y. (U. S. No. 1,160,590; Nov. 16, 1915.)

PEAT—Apparatus and Process for the Heat Treatment of Peat. Nils Testrup, London, England, and Thomas Rigby, Dumfries, Scotland, assignors to Wet-carbonizing Ltd., London, England. (U. S. Nos. 1,160,463 and 1,160,464; Nov. 16, 1915.)

PRECIPITATING APPARATUS AND METHOD. Harry R. Conklin, Joplin, Mo. (U. S. Nos. 1,160,845 and 1,160,850; Nov. 16, 1915.)

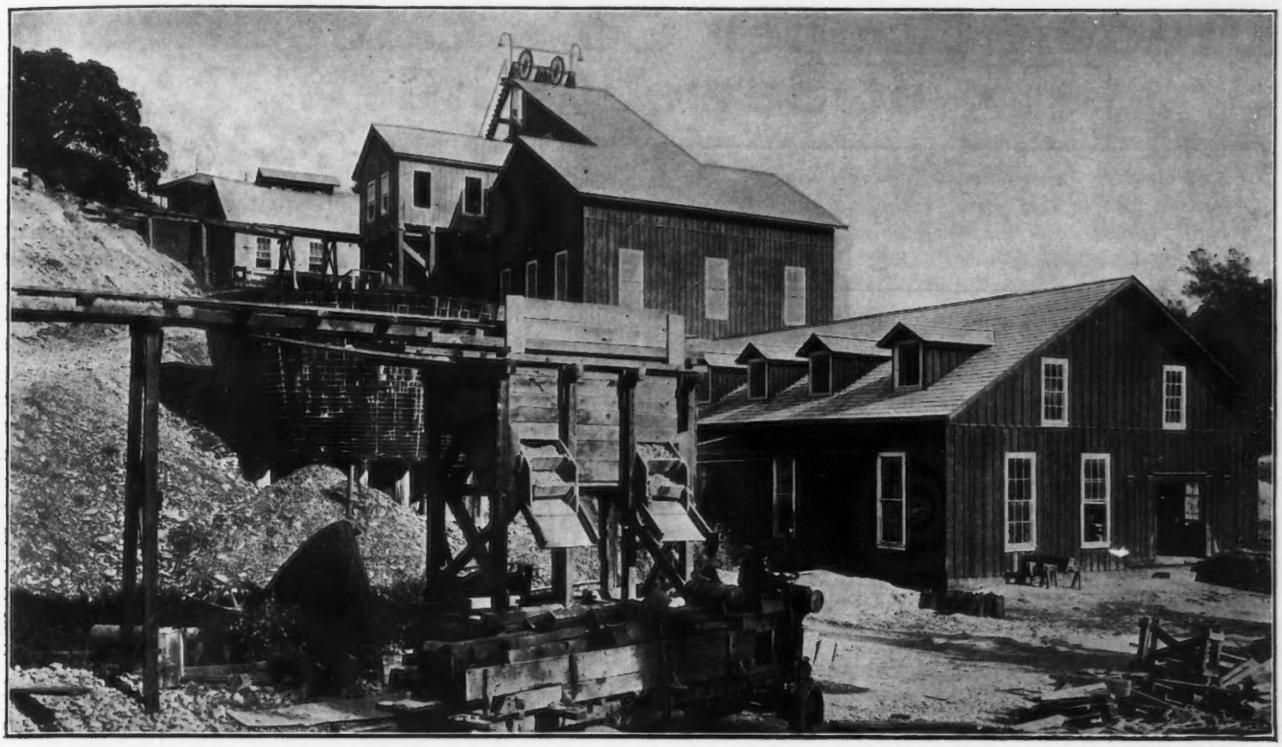
SCREEN—Vibrating Screen. Randall P. Atkins, Denver, Colo., assignor to Colorado Iron Works Co., Denver, Colo. (U. S. No. 1,160,812; Nov. 16, 1915.)

Photographs from the Field

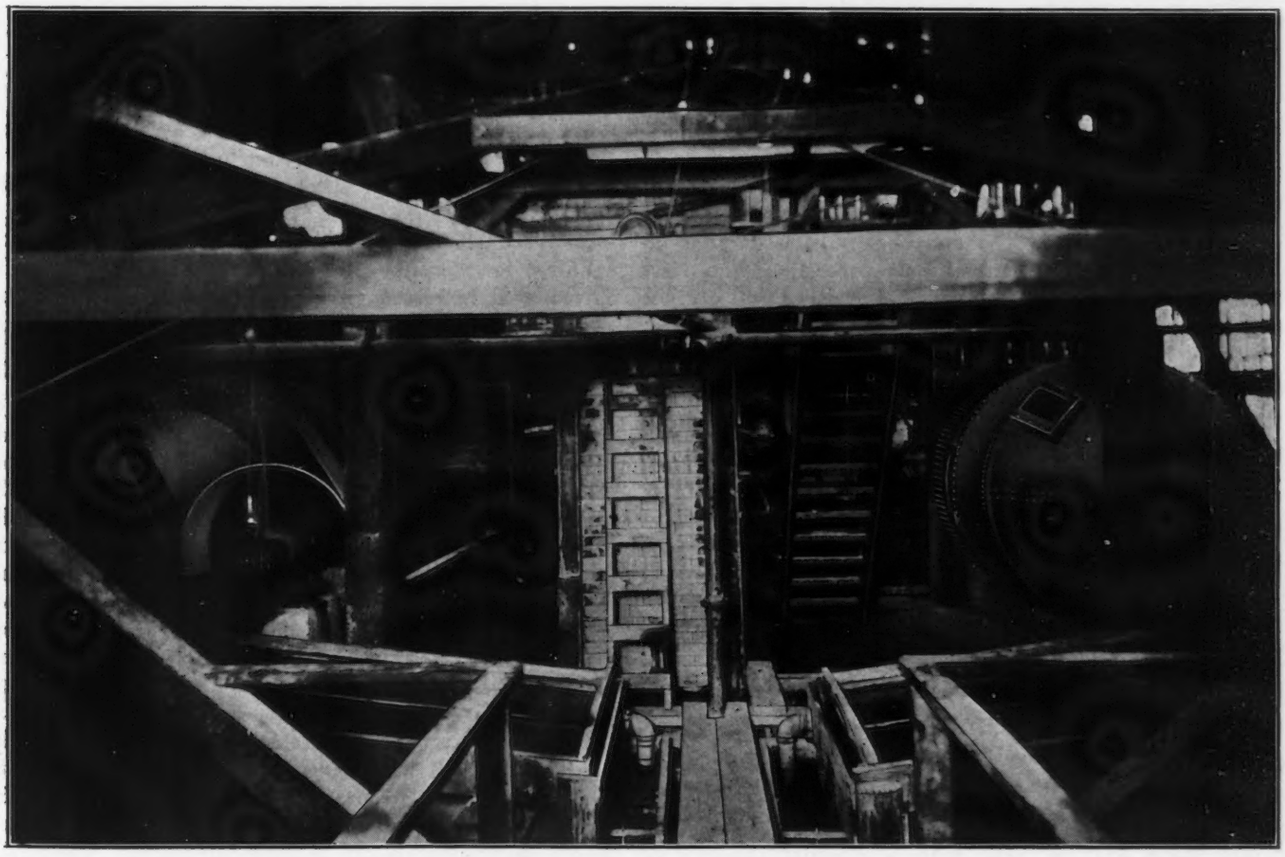


SOME OF THE HOMESTAKE MINING CO.'S MANY IMPORTANT UNITS

1—The stamp mills at Terraville. 2—The Father de Smet 100-stamp mill. 3—The pumping station at Hanna, where three 2,000-gal. steam pumping engines are being replaced by Jeanesville electric-driven centrifugal pumps. Water is elevated 387 ft., and then flows by gravity to Lead. 4—Electric generating station at Englewood. Water pumped over the divide is here utilized to generate power, using a Pelton wheel. 5 and 6—Interiors of Englewood power plant. 7 and 8—In the regrinding plant at Lead, showing tube and Hardinge mills



The mill uses amalgamation, concentration and cyanidation, handling the usual type of Mother Lode ores. It is equipped with 40 stamps and Hardinge mills for regrinding. The concentrates are cyanided in a Trent agitator and replacer, and solutions precipitated with zinc dust. The mill has a capacity of 300 tons daily



AN INTERIOR VIEW OF THE AMADOR CONSOLIDATED MILL

The stamps, regrinding mills and amalgamation tables are shown. The operation of this mill was described in the "Journal" of Aug. 14, 1915

Braden Copper Co.'s Concentrator at Sewell, Chile*

SYNOPSIS—A condensed description of the Braden Copper Co.'s ore-dressing equipment. The main features of the operation are briefly explained by the Braden mill staff.

The crushing plant and concentrator of the Braden Copper Co. at Sewell, Chile, are about two kilometers west of the mines on the northern side of the Teniente River. The topography of the mill site is such that full advantage is taken of a gravity flow of the ore, whether it is in its dry state as it comes from the mine, or after the addition of water as it is handled in the mill. The difference in elevation between the top of the coarse-ore bins, where the ore is received from the mine, and the bottom of the filter-press plant is 403 ft. The area covered by the entire concentrating plant itself is 130,000 sq.ft.

The Coarse-Crushing Plant

The ore is transported from the mine to the coarse-ore bins by means of an electric railroad. The bins have a storage capacity of 2,300 tons. Mechanical feeders deliver the ore to a belt-conveyor system that carries it to the crushing plant. The crushing plant is divided into two sections having the same number of machines and the same rated capacities; only one section will be described. The ore passes over a 1½-in. grizzly, the oversize falling directly into a gyratory crusher; the fines join the crusher discharge, which has been reduced to an average diameter of less than 2 in. These two products are then crushed to ⅞ in. in a pair of rolls 6 ft. in diameter and 20 in. wide.

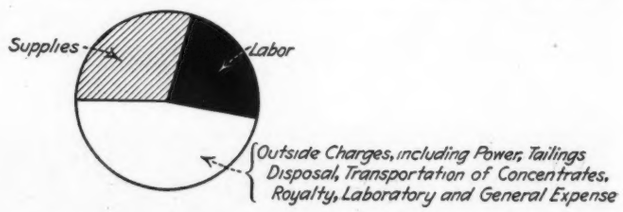
The discharge of the 72x20-in. rolls is divided into two parts, each passing into a trommel having diagonal openings, 6x30 mm. The undersize is carried direct to the fine-ore bins by means of conveyor belts. The oversize is fed into a 48-in. Symons disk crusher that crushes the ore to ⅝ in. between two manganese-steel disks rotating in the same direction and at the same speed, but supported at an angle to each other. The discharge of the Symons crushers passes over Colorado Iron Works Impact screens with openings 6x30 mm. The undersize goes to the fine-ore bins by means of the conveyors already mentioned. The oversize is crushed in two sets of 36x15-in. rolls. The discharge of these rolls is raised by a bucket elevator to another set of Impact screens, the oversize being divided, approximately one-third to the two 36x15-in. rolls mentioned above, and the remainder to two more 36x15-in. crushing rolls, for further grinding until all the ore will pass the 6x30-mm. openings of the screens. The fine-ore bins have a storage capacity of 3,000 tons.

Concentrating Mill in Three Sections

The crushed ore is delivered to the concentrator building by means of belt conveyors. The mill is divided into three sections, each with a nominal capacity of 1,200 tons per 24 hr., only one of which will be described as the other two are similar.

From the final belt conveyor the ore passes over four Impact screens with 25 openings to the square inch, making a separation between the smaller particles, which can now receive their first concentration, and the larger ones, which require further grinding in order to liberate the sulphides. The oversize from the screens is fed to two sets of rolls, then to an elevator, the discharge of which joins the fines that have passed the screens. At this point water is added and the ore flows to four trommels with screens having the same-sized opening as the Impacts. The material passing through these trommels is fed to six Wilfley tables. The concentrates flow to the collecting tanks at the foot of the mill, while the table sands, which need further grinding, are conducted to eight Hardinge mills; the oversize from the trommels is also fed to these mills.

The Hardinge conical mills make 28 r.p.m. and are half-filled with pebbles having a maximum diameter of 5 in. All the discharge is now run to two drag classifiers, the sands from which are concentrated on six Wilfley tables, the concentrates going to the collecting tanks, and the reject sands to the next floor of Hardinge mills for further grinding. On this floor there are six mills, which reduce the reject or table tailings to the size required for the final concentration. Each of these mills is operated in closed circuit with a drag classifier, the overflow of which runs direct to the flotation plants.


Supplies
Labor
Outside Charges, including Power, Tailings Disposal, Transportation of Concentrates, Royalty, Laboratory and General Expense

DISTRIBUTION OF CONSTRUCTION EXPENSE

Ore Ground to 60-Mesh for Flotation

The ore has now been ground so that all but 10% will go through a 60-mesh screen. The final concentration is effected by means of the Minerals Separation process. This is carried out in eight standard M. S. units that treat the tonnage handled by the three mill sections. The float from the last two boxes of each unit is low in copper and is collected separately and retreated, being pumped back to join the original feed.

The tailings, from which most of the copper has now been extracted, are all collected into one launder, passed through a sampler, and then conducted down the valley to the tailings dam, where they are stored.

The concentrates are collected in concrete tanks at the foot of the mill and loaded by means of a crane into railroad cars for removal to the smelting works. The overflow of these tanks, consisting of sulphide slimes too wet to be smelted, is run to Dorr thickeners. The thickened concentrates are further dewatered in two types of machines: the Kelly press and the Oliver filter. The

*Excerpts from a preliminary article by the Braden mill staff in "Teniente Topics" for October, 1915.

product of both machines is loaded directly into railroad cars for transport to the smelting plant.

OPERATING DATA, BRADEN MILL

Tons per man per day	8.50
Kilowatt-hours per ton milled	29.60
Acid per ton milled, lb.	7.00
Tar oil per ton milled, lb.	2.00
Fuel oil per ton milled, lb.	0.30
Local pebbles per ton milled, lb.	8.75

On account of the situation of the plant in a foreign country, the long distance from the main base of supplies, the duties and ocean freight on all sorts of material bring the item of supplies up to 60.4% of the total direct milling costs. The percentage of total costs assessable to the various departments, for labor and supplies respectively, is shown in an accompanying table. The relative proportion of the total milling charges is indicated in the diagram.

DISTRIBUTION OF DIRECT MILLING COSTS AT BRADEN

	Labor %	Supplies %
Coarse-ore bins and conveyors	4.07	2.51
Crushing plant	21.29	16.02
Fine-ore bins, conveyors, mill rolls and screens	9.02	7.17
Table concentration	7.04	2.97
Hardinge mills	21.98	25.00
Oil flotation, main plant and retreatment	22.81	42.58
Concentrate handling	8.33	1.14
Filtering M. S. concentrates	5.46	2.61
	100.00	100.00

Interstate-Callahan Report

The third annual report of the Interstate-Callahan Mining Co., Wallace, Idaho, for the fiscal year ended June 30, 1915, has been issued. For the fiscal year ending June 30, 1914, there was an operating loss of $99,315. During the year just closed, this deficit was wiped out, dividends aggregating $697,597 were paid and a surplus of $1,094,862 was accumulated. Ore was extracted during the year from four levels, only development work being done below No. 4. There is enough ore above No. 6 to last the mill for four years. An average of 180 men was employed in the mine and mill, and 309.5 tons of ore per day was sent to the mill.

Shipments of concentrates and crude ore totaled 41,963 tons. Income totaled $2,161,177.53, distributed as follows: Crude lead ore, 246 tons, $6,451; crude zinc, 8,473 tons, $421,238; lead concentrate, 2,563 tons, $90,096; zinc concentrate, 30,681 tons, $1,628,499; miscellaneous income, $14,895. Expenditures totaled $569,404.38, divided as follows: Mining and milling, $470,967; interest, $18,088; improvements, $80,350. The surplus after paying $697,597.50 in dividends was $894,175.65, to which is added $300,000 derived from the sale of bonds, less $99,313.64 loss in 1914, leaving $1,094,862.01 in the treasury.

The report of C. W. Newton, mine superintendent, covers only the first six months of 1915. Development work during this period totaled 1,510 ft.: Shaft, 25 ft.; crosscuts, 639 ft.; drifts, 814 ft.; raises, 32 ft. Ore mined totaled 56,025 tons: No. 2 stope, 3,921 tons; No. 3 stope, 19,924 tons; No. 3½ stope, 11,433 tons; No. 4 stope, 18,478 tons; development 2,269 tons.

Feldspar Production Marketed in the United States in 1914 was 135,419 tons, the largest annual recorded output. The sales of crude spar were 85,905 tons, and of ground spar 49,514 tons. The quarries are, with a single exception, restricted to the Eastern seaboard states, the exception being in California. It is chiefly used in the manufacture of pottery, enamel ware and electrical ware, according to the Geological Survey.

Mineral County, Montana, Mining Notes

By Hubert I. Ellis*

There is greater activity now in mining and prospecting in Mineral County, Mont., than for many years past. The principal centers of activity are Saltese, in what is sometimes known as the "East Cœur d'Alenes," and Superior, the county seat. The Superior mineral belt is probably better known as the Iron Mountain district, from the old Iron Mountain mine and the station of the same name on the Northern Pacific Ry. about a mile from Superior, which is on the C., M. & St. P. Ry.

The earliest mining in the area tributary to Superior was on Cedar Creek, which empties into Missoula River from the south about a mile above the town. Placer gold was discovered on Cedar Creek in 1869 and soon afterward on certain of its head-water tributaries, notably Oregon, California and Snowshoe Gulches, and on Freezeout and Deep Creeks. Walla Walla, Wash., was the supply center, provisions and such equipment as was essential being freighted to the mines by pack-train. Flour sold for $18 a hundred, according to an old account book found in a deserted cabin, and wages were $5 a day.

Early Mining Activities in the District

Some of the placers were rich, and it was not unusual for a small crew to average $80 or more each per day. Cedar Creek alone is credited with a production of nearly $3,000,000, which came chiefly from the upper portion of the creek and from Oregon and California Gulches. Drifting in the early days and hydraulicking at a slightly later date were the usual methods of working, although some deposits were worked by opencuts. The mining of placer gold is no longer an important industry, although the Cedar Creek Gold Mining Co. is operating a dredge 14 mi. from the mouth of the creek and 4 mi. above the Amador copper mine. The dredge was installed in 1907 and has worked every summer since. It was originally planned to operate throughout the year, and a steam-power plant for generating electricity was built 2 mi. below the dredge. It was soon found that the freezing of the surface precluded the possibility of winter dredging, and water power, being plentiful in summer, was substituted for steam for driving the generators. Water is taken from Cedar Creek, ¾ mi. below the dredge, and led through wood pipe of about 24 in. diameter to the power plant. The dredge, which seems to have been a money-making enterprise during the last three or four years, has a large area of practically virgin ground ahead, some of which has been prospected by Keystone drill.

The only producing lode mine on Cedar Creek is the Amador, 10 mi. from the mouth of the creek. A deposit of high-grade copper ore was found by the placer miners in cleaning bedrock, but no attention was paid to it at the time. Lode claims were eventually located, and a large amount of work was done by the old Amador company, which obtained the claims from the original locators. An adit on the vein was started on the left limit of the creek, but the showing in this seems to have been less encouraging than that in the creek bed and a winze was sunk a short distance from the portal. Ore was stoped to a

*Mining engineer, Kellogg, Idaho.

depth of 400 ft. A standard-gage railway was built to the mine from the Northern Pacific tracks at the mouth of the creek, and a smeltery was built at the junction where the town of Amador, now deserted, was founded. Partly owing to dissension among the stockholders, the mine was closed down in 1907, after a career said to have been featured by extravagance and general mismanagement. During the current year it has been taken over by the Intermountain Copper Mining Co. and reopened to a depth of 400 ft., on which level there is a 300-ft. shoot of milling ore ready for stoping. The flume, which diverts water from Cedar Creek and delivers it to the compressor plant at the tunnel portal, has been repaired. A new 100-ton concentrator is being built to treat the ore by jigging, table concentration and flotation, and it is expected to start early in November.

Prospects Attracting Attention

There are, near the Amador, other promising prospects that are receiving considerable attention. On Mary Ann gulch, 5 mi. below the Amador, is the Golden Sunset gold prospect, owned by Kittinger, Shattuck and associates. The ore is rich, but its occurrence is irregular. On the Gold Crag, at the head of Cedar Creek, Fuller brothers have driven 450 ft. of a 750-ft. crosscut tunnel to tap the vein at 500 ft. under a promising surface showing. On the divide between Freezeout and Snowshoe Creeks the Gildersleeve brothers have traced a copper-lead vein several hundred feet. At the head of Oregon Gulch and Deep Creek there are several gold prospects on which considerable work has been done, but nothing of value has been found.

One of the most promising properties in this area is that of the Clearwater Gold and Copper Co., which lies across the range on the Little North Fork of Clearwater River, in the State of Idaho. Two adits have been driven on the vein, the upper 1,200 and the lower 1,400 ft., and a winze has been sunk 100 ft. from the lower adit on an oreshoot 20 ft. in width. A small sawmill has been built, and the property is equipped with compressor and air drills. Only the lack of transportation facilities prevents this mine entering the list of producers. The most feasible outlet, in the absence of a railway, is probably by aërial tram to the Amador mine, a distance of 15 mi. over comparatively easy country.

The Iron Mountain, on Flat Creek, is the most important of the mines lying northwest of Superior. It is an old producer, the first mining having been done about 1887, and thousands of tons of silver-lead ore has been treated in the mill. The mine was closed in 1898, when the Montana law requiring two openings went into effect, and was practically idle until 1906, when work was started on a 5,680-ft. adit cutting the vein at a depth of 1,600 ft. A winze was later sunk, and the deepest workings are 2,200 ft. from the surface. Shipments of crude ore and concentrate were made regularly during the last two years until this summer, when the Federal Mining and Smelting Co. bid in the property at sheriff's sale for $110,000. The mill is receiving a thorough overhauling and will be operated.

Near the mouth of Flat Creek the Gildersleeve brothers have installed two Brookwater jigs to rework the old Iron Mountain tailings for zinc and lead, and have recovered as high as 3,000 lb. of 30% zinc concentrates in 24 hr. The operators plan to build a larger mill and will experiment with regrinding and flotation.

There are several copper prospects in the vicinity of Superior on veins associated with persistent dikes of a dark-colored basic rock, probably diabase. Oxidized copper minerals and some sulphides appear on the surface at intervals for several miles, and several bodies of commercial ore are reported, but insufficient work has been done to determine their true value. At the Superior-Montana group, on Kelly Gulch, a 470-ft. adit has been driven on one of these deposits; the copper ore carries $6 to $60 per ton in gold, but its occurrence is irregular. McKinnon has recently found a shoot of shipping ore on the same vein on Spring Gulch, and Whitmarsh, on a similar vein at the head of Thompson Creek, reports several feet of ore, much of which can be shipped crude in the face of a crosscut tunnel.

The Little Anaconda, at the head of Deep Creek and on the continuation of the Iron Mountain lode, is idle at present, the last shipments having been made two years ago. The adjoining Glen Metals mine is under lease to C. B. Etnier. The property has 3,000 ft. of development work on two veins, one of which is opened to a depth of 1,400 ft. and the other to 800 ft. A shipment of 65 tons taken from a shoot 1 to 4 ft. wide and 400 ft. long averaged 15% Zn, 20% Pb, and 10 oz. Ag per ton. At the eastern end the shoot carries 25% Pb and 10 oz. Ag. Shipments will be made from this portion to Northport as soon as the new plant is completed. Driving on No. 2 vein has been under way since Sept. 1; the face shows 7 ft. of milling ore. The King & Queen has been shipping for several years, and preparations are making for reopening the Little Pittsburg. The Red Elephant gold mine is working on a small scale, and the O. R. & N. is driving tunnel by contract.

Near Saltese, on Packer Creek, the Last Chance, which has shipped considerable high-grade silver ore, is being reopened. The Tarbox, Bryan and Hemlock, also on Packer Creek, are being developed. On the Hemlock drifts from the 150-ft. shaft show a shoot of lead-silver ore several hundred feet long. The Wilson Mining and Smelting Co. owns two groups of claims, one lead and the other copper. A crosscut is driving to cut the copper vein at a depth of 125 ft., and it is planned to resume work on the lead group during the winter. From the head of Silver Creek the Richmond is shipping copper-gold ore at the rate of four cars per month. A contract has been let for an aërial tram a mile long to deliver ore to the railway at Adair.

Natural Advantages Warrant Greater Development

Considering the varied mineral resources of Mineral County, it is surprising how little prospecting, except of the most desultory sort, has been done in recent years. The district is served by two railways, the branch of the Northern Pacific to the Cœur d'Alenes and the main line of the Chicago, Milwaukee & St. Paul, and since most of Mineral County drains into the Missoula River, transportation is a simple problem. Power at reasonable rates is available from Thompson Falls, and there is sufficient water in the creeks for many of the mines to have their own plants. Timber of satisfactory grade is abundant. Years of work on the Amador and Iron Mountain mines have demonstrated the continuity of the orebodies, and it is highly probable that new mines will be opened as a result of the present increased activity.

Editorials

Revision of the Mining Laws

Great interest is being exhibited in the convention to be held in Washington on Dec. 16, 1915, which was called by the Mining and Metallurgical Society of America and is to be conducted under its auspices. The purpose of this gathering of mining men is to urge upon Congress the desire of the citizens engaged in the mining industry that the mining laws of the United States be revised as speedily as possible. Upon this there appears to be remarkable unanimity of opinion. It is agreed, moreover, that there should be no piecemeal revision, but a thorough coördination of the whole system; and that a new law providing for this should be drafted upon the basis of the findings and recommendations of a commission to be appointed by Congress to study the subject. Upon these principles the Mining and Metallurgical Society of America, the American Mining Congress and the American Institute of Mining Engineers have taken formal action in perfect agreement, while many of the local mining societies of the country have done the same thing.

The need for a revision of the mining laws has been agitated for a good many years. Society after society has voted in favor of it, commission after commission has recommended it, but the final step to bring it about has not yet been taken. There are certain reasons for this, such as the inertia of Congress, the opposition of certain persons who conceive that their private interests will be adversely affected and the hugeness of the task of writing a new law. In discussions of this question some congressmen have offered to introduce and push any bill that the mining societies would put in their hands, but this was beyond the means of the societies. The preparation of such a bill—assuming the work to be thoughtfully done—is a task involving a great deal of time and expense. This is why the study of the question, the hearing of opinions and wishes in all parts of the country and the drafting of a bill should be delegated to a commission of congressional authorization. Such points as these ought to be brought out in the forthcoming convention.

The Mining and Metallurgical Society of America has had mining-law revision under consideration for a good many years. The report of its committee on mining laws is probably the most instructive literature upon the subject that has been offered. Following this report and the discussion of it in meetings of the society, a series of resolutions was submitted to the membership. Some of these resolutions were carried by an all but unanimous vote, others by only a bare majority, illustrating the nature of the differences in opinion that develop when details come into question. In issuing its invitations to the convention in Washington, the council of the Mining and Metallurgical Society said that it would offer only those resolutions upon which its membership was substantially unanimous. At a meeting of this council last week that action was rescinded, and it was decided to offer only those resolutions embodying the broad principles that there should be a complete and coördinating revision of the mining laws and that a commission to study the matter should be authorized by Congress. All other points, such as the question of extralateral rights and the question of discovery as a prerequisite to location, will come naturally within the purview of such a commission and need not be discussed at this time, when the main thing is to get a commission.

A matter which will, however, be usefully discussed in Washington pertains to the nature of such a commission—whether it should consist of three members, or five, or seven; whether lawyers or mining men should predominate in it; whether it should be paid or unpaid. These and many other questions are of vital importance. The great idea in the forthcoming meeting, however, is for mining men from all parts of the country to assemble in Washington and let Congress know that they want to have something done; and that, moreover, they will be able to propose a specific, practicable and conservative program, respecting which everybody will be substantially in agreement.

The Kennecott-Braden Deal

One of the most curious transactions in copper-corporation affairs is that which was announced last week, whereby the Kennecott Copper Co., operating mines in the Copper River region of Alaska, is to take over the Braden company, operating mines in Chile; and furthermore, is to acquire the interest (about 400,000 shares) of the Guggenheim Exploration Co. in the Utah Copper Co. No reason based on economy in operation of these far-apart mines has been advanced, nor has the public been apprised of any explanation of what it is hoped to accomplish.

The Kennecott, Braden, and Guggenheim Exploration are concerns in which the Guggenheims are largely interested. The Guggenheim Exploration Co., which is essentially a holding company, has been advertised in the squibs in the Wall Street journals as about to be dissolved. The Braden company has been borrowing several millions of the cash assets of the Guggenheim Exploration. The Kennecott company, which represents a huge investment in Alaska by the houses of Morgan and Guggenheim, was offered to the public for investment several months ago, in connection wherewith there has been a shrewd stock-market propaganda. The Utah Copper Co. plays no part in the deal, but the Guggenheim Exploration Co. owns a large block of its shares.

The Braden company owns a great mine, but it has experienced disappointments and probably was still far short of the time when it, going alone, could safely begin the payment of dividends. On the other hand, the Kennecott company, which made its début in Wall Street about the time when copper rose to 20c. per lb. last spring and soon afterward discovered what was heralded as the richest copper bonanza ever known, will soon be

in a position to begin the payment of dividends. The Braden and Kennecott mines are, in short, the antitheses of each other. Both are situated in remote regions and are subject to violent vicissitudes of climate, labor conditions, etc. The Kennecott mines are far up in the Northern Hemisphere and the Braden mines far down in the Southern. The latter have low-grade ore, a lot of it, and the probability of long life. The Kennecott mines have phenomenally high-grade ore, but there is doubt as to how long it will hold out. The idea of the Braden-Kennecott combination appears to be to average things. The Braden stockholders will probably not object to this. The Kennecott company is too new a thing to have a large list of stockholders of the investment class.

The strangest thing in the deal is the taking-over of the Utah shares from the Guggenheim Exploration Co., the latter receiving Kennecott shares in exchange. If the Guggenheim Exploration Co. is going into liquidation and is going to distribute its assets among its stockholders, the latter will get Kennecott shares instead of Utah shares. The principal Guggenheim stockholders are quoted in the Wall Street prints as talking as if they liked this. Of course there's no accounting for tastes. The Kennecott company will naturally increase its list of stockholders.

Some Prodigious War Wastes in Minor Items

High-explosive shells, which according to the newspapers are being fired at the rate of 1,000,000 a day on some of the 100-mile battle fronts in Europe, are of forged steel, made hollow to contain the bursting charge of explosive, and the nose of the shell threaded, into which is later screwed the nose detonating fuse. Between the time the shell is completed ready for shipment and its fusing prior to the action in which it is required, this opening in the nose of the fuse is closed by a plug screwed in temporarily.

The British have been using a brass plug for this purpose. The 4½-in. high-explosive shell manufactured in Canada has a brass plug which weighs 10½ oz., is very carefully machined and threaded, and screws into the nose of the projectile easily by hand, but has a square recess in the top for the insertion of a square-end wrench in case it cannot be unscrewed by hand. In the absence of specifications or an analysis of this particular plug, it is not possible to say just how high-grade this particular brass is, but if it conforms to specifications for other war material it can be assumed to be of the very highest grade and therefore the most costly. When the shells are fused in the battle area, these plugs are taken out and thrown away and are a total loss. If 1,000,000 of them were thrown away in one engagement in one day, some idea can be formed of the prodigous waste of war, so far as this item of copper and zinc is concerned. This of course is by no means the only use of copper and zinc in ammunition or for that matter on the explosive shell itself. The same shell that has this nose plug wasted has a copper rotating band near its base and has a time detonating fuse in its nose, both of which are converted into fragments on the explosion of the shell.

These same plugs when used for Russian shells are made of zinc. Information is not at hand about the grade required or specified for this purpose, but in any event the cost is excessive and the waste and loss complete.

There is no valid reason for making these temporary plugs of the most expensive material available, and evidently this has dawned upon those at the head of the munitions manufacturing department in England, because wood plugs are now being used for this purpose in place of the more expensive metals. Recently a manufacturer of war material was approached for a bid on a large number of these nose plugs. His figure, scaled down to the minimum, was more than a million dollars. This price being unsatisfactory to the representative of the foreign purchaser, the bidder made an alternative figure, which was less than $^1/_{400}$ of the first, if he were allowed to make the plugs out of wood. The turning of these plugs from wood and the cutting of a satisfactory thread on them is said to be one of the most difficult manufacturing details, but they are now being turned out and used and, so far as is known, with perfectly satisfactory results.

We have it from an authoritative source, that one reason why the Russian supply of ammunition was so slow in coming forward was because, prior to the exigencies of the recent campaigns, the Russian specifications required that all of their projectiles be nickel-plated, and neither the time nor the nickel was available for fulfilling these requirements on the vast number of shells that were being expended on the battle front. Nickel-plating the projectile of course reduces the wind resistance during its flight and therefore increases both its range and penetration, but with the modern grinding machine it is probable that nickel-plating the projectile does not gain any advantage over proper grinding and polishing, which are now done so cheaply and efficiently by United States manufacturers.

When these time fuses, which are very delicate pieces of mechanism, are manufactured and shipped, it is necessary to have them protected from moisture and dirt and dust. This is accomplished by covering them with a veil of tin-foil, which is wiped over the conical fuse. These veils are peeled off and thrown away when the fuse is put in the shell.

There was in the market recently an order for 25,000,000 fuses for the Russian government. The bidders were unable to find sufficient supplies of tin-foil, or the sources of such supply, to fill this order, and after a great deal of haggling, they succeeded in getting the specifications changed, substituting for tin-foil a lead-foil tinned on both sides, and by this means succeeded in providing sources for war material for the coverings required. This order of 25,000,000 was only a small part of the total order in hand, to be placed at that time.

This gives another idea of the prodigious waste of the less common and semi-rare metals in this war, and in both cases these wastes are minor items.

Mr. Manning is already showing in his conducting of the Bureau of Mines his earnest desire to live up to the traditions of Doctor Holmes. The guiding spirit is to make the bureau a useful thing to the mining industry and to keep in close touch with the men engaged in that industry in order to help in solving their problems. There is no policy of aloofness in this bureau, but rather the idea that mining men who visit Washington are welcome and that it is a good thing to talk matters over. This is of course just as it ought to be.

Liquidation Plan, Guggenheim Exploration Company

The Guggenheim Exploration Co. sent out a circular letter to its stockholders on Nov. 23, giving its liquidation plan. The letter, which is signed C. K. Lipman, the secretary, reads in part as follows:

For some time the directors have had under consideration the advisability of liquidating the business of the company and of distributing its assets among the stockholders. It is believed that the present is an opportune time for accomplishing that purpose. The most valuable single investment of the company consists of 404,504 shares of the capital stock of the Utah Copper Co. The directors deem it impracticable to dispose of this large block of stock in the open market at its fair value, and they consider it unwise to distribute it among the stockholders under conditio' s likely to result in a substantial shrinkage in values, to the injury of all concerned.

An opportunity has now presented itself which will enable the company to sell these shares to the Kennecott Copper Corporation on terms that will obviate these difficulties. It is proposed that the latter corporation shall purchase this entire block of Utah Copper Co. stock by giving in exchange therefor 1½ shares of its own stock for each share. The Kennecott Copper Corporation is perfecting arrangements with a syndicate which will purchase the requisite number of shares of the Kennecott Copper Corporation received by the Guggenheim company, whereby the stockholders will be enabled to elect whether they desire their proportions of the proceeds of the sale of this block of stock to be distributed to them in the shares of the Kennecott Copper Corporation or in cash at the rate of $75 per share for the stock of the Utah Copper Co. so sold.

The Kennecott Copper Corporation was organized on Apr. 29, 1915, under the laws of the State of New York. It has issued 720,000 shares of stock, without nominal or par value. Its present capital is fixed at $6,000,000. On May 27, 1915, it acquired the mining claims and property in Alaska known as the Kennecott mines, and shortly thereafter there was conveyed to it the mining property in Alaska formerly belonging to the Beatson Copper Co. These constitute copper producing properties upon which extensive valuable mineral deposits have been developed. The extraction of ore has been in progress on these properties in constantly increasing volume for several years past. The Kennecott Copper Corporation has now outstanding an issue of $10,000,000 first-mortgage 6% 10-year gold bonds, convertible into stock in the ratio of 40 shares of stock for each $1,000 bond. It has no floating debt except for current liabilities and for advances made against copper already sold.

The Kennecott Copper Corporation proposes, if it can do so on fair terms, to acquire additional properties and property rights, and to that end contemplates an increase of the number of its shares, which are to be issued without nominal or par value, from 720,000 to 3,000,000 shares, and of its capital from $6,000,000 to $15,000,000. The 2,280,000 of new shares are intended to be devoted to the following purposes, to the extent stated:

1. For the purchase of the 404,504 shares of Utah Copper stock owned by the Exploration company, 606,756 shares.
2. For the purchase from the respective owners thereof the shares of stock, convertible bonds and convertible debentures of the Braden Copper Mines Co., 800,000 shares.
3. For the purchase from the Alaska Syndicate of 48,174 shares of the capital stock of the Copper River & Northwestern Ry. Co., of the par value of $100 each, being its entire outstanding capital stock, of $23,020,000 par value of the 5% 50-year gold bonds of said railway company, being all of its outstanding bonds, and of 13,000 shares of the capital stock of the Alaska Steamship Co., of the par value of $100 each, out of a total authorized outstanding capital stock of 30,000 shares, 200,000 shares.
4. For the retirement of the $10,000,000 of convertible bonds of the Kennecott Copper Corporation, 400,000 shares.
5. For the compensation to be paid to an underwriting syndicate in consideration of the services rendered by it to the Kennecott Copper Corporation to meet the cash requirements of the proposed plan, which involves alternative offers of cash to the holders of the securities mentioned in the above subdivisions (1), (2) and (4), 65,000 shares. Total, 2,071,756 shares.

The remaining 208,244 shares of new stock and such of the shares above specified as may not be used for the purposes indicated will be available for the general corporate purposes of the Kennecott Copper Corporation.

The Messrs. Guggenheim, who are officers and directors of your company, are the owners of large holdings of the stock, bonds and debentures of the Braden Copper Mines Co. and of the stock and bonds of the Kennecott Copper Corporation. They are also members of the Alaska Syndicate, and as such are largely interested in the securities which the Kennecott Copper Corporation proposes to purchase from that syndicate and in the shares of stock of Kennecott Copper Corporation owned by such syndicate. Messrs. J. P. Morgan & Co. are likewise the holders of large amounts of the bonds of the Kennecott Copper Corporation, and are members of the Alaska Syndicate. That firm, as well as the Messrs. Guggenheim, and the directors of some or all of the corporations herein named, may become subscribers to the underwriting syndicate, when organized, and participate in its compensation.

Upon the consummation of this proposed sale of the shares of the Utah Copper Co., it is the present purpose of your directors, while retaining in the corporate treasury property exceeding in value the capital stock of your company, to make a distribution of a portion of its assets among its stockholders, as follows:

a. The proceeds of the Utah Copper Co. stock, by paying to such stockholders as shall elect to take their proportionate share of such proceeds in cash, $36.38 7/10 in cash for each share of the Guggenheim Exploration Co. and to such stockholders as shall elect to accept shares of stock in the Kennecott Copper Corporation 72.77% of a share of the stock of the latter company for each share of the stock of the Guggenheim Exploration Co. held.

b. 97,750 shares of the capital stock of the Chino Copper Co., by transferring to each stockholder of the Guggenheim Exploration Co., 11.72% of a share of Chino stock for each share of the stock of the Guggenheim Exploration Co.

c. 69,500 shares of the common stock of the American Smelting and Refining Co., by transferring to each stockholder of the Guggenheim Exploration Co. of 8.33% of a share of common stock of the Smelting Company for each share of stock of the Guggenheim Exploration Co.

d. 154,300 shares of the capital stock of the Ray Consolidated Copper Co., by transferring to each stockholder of the Guggenheim Exploration Co. 18.50% of a share of the stock of the Ray company for each share of the stock of the Guggenheim Exploration Co.

Pan-American Scientific Congress

We are requested by the authorities in charge of this congress to announce that in addition to the general topics described in the preliminary program, issue of Apr. 15, the executive committee of the Second Pan-American Scientific Congress, which is to meet in Washington Dec. 27, 1915, to Jan. 8, 1916, has authorized the following important special topics, which will be discussed in a series of Pan-American conferences, a conference on each topic:

Mining—The mining law of each country and the changes that may be made to aid the development of mineral resources. History of the mining industry in each country with reference to the beginnings of that industry. The development of the Patio process. Bibliography of mining.

Metallurgy—Present methods of concentrating ores and the development of concentration methods.

International relations in the exchange of ores and metals.

Bibliography of metallurgy:

A and B. Mining and Metallurgy—Development of hydroelectric power for mining and metallurgy, the amount probably available, and specific benefits from its utilization.

C. Economic Geology—The relation of geological work to the development of the country. A bibliography of economic geology.

D. Applied Chemistry—Natural and artificial nitrates; the present status and the outlook for these industries.

Safety Last

Pumping a man full of compressed air is still considered a joke by some people. Besides the case recently reported by the *Journal,* a worker at the Midvale Steel Works in Pennsylvania was subjected by two facetious fellow workmen, to an air hose containing air at a pressure of 80 lb. per sq.in. Immediate injury was not discovered, but soon after the man was suddenly taken ill while at work. At the hospital it was discovered that almost every internal organ had been ruptured by the air pressure, and it is not expected that the man can live. The fool-killer is a long way behind in his work.

Revision of Mining Laws

The Council of the Mining and Metallurgical Society of America—at the invitation, and under the auspices, of which a convention of mining men is to be held in Washington, D. C., on Dec. 16, to urge upon Congress the desire of the mining industry that the mining laws of the United States be revised—requests us to publish the following rules for the conduct of this convention, adopted at its meeting on Nov. 18:

The meeting to comprise three sessions, the first beginning at 10 a.m., the second at 2 p.m. and the third at 8:30 p.m.

The meeting to be organized with the president of the Mining and Metallurgical Society in the chair. The presiding officers in the several sessions to be the presidents of the M. M. S. A., the American Institute of Mining Engineers and the American Mining Congress, or representatives of those organizations.

A committee on credentials, three members, to be named by the Mining and Metallurgical Society of America.

The several sessions to be open to all persons interested in the mining industry, but the right of voting to be limited to accredited delegates and other persons especially invited.

Credentials to be: (1) Membership in the societies invited; (2) Representatives, one each, of chambers of commerce especially invited. Representatives, one each, of operating mines in the United States, provided that any such mines have no representation through membership in a society, or otherwise. Representation in all cases to be limited to citizens of the United States. Credentials to be passed upon by the committee on credentials, whose decision will be final.

A committee on rules, three members, to be appointed by the chairman.

A committee on resolutions, five members, to be appointed by the chairman.

All resolutions to be submitted to the committee on resolutions.

The committee on rules to have the right to make provisions limiting and concluding debates, if necessary.

We are further informed that the outlook is for a large and representative attendance. Persons attending the meeting are requested to register in the record book that will be provided for the purpose. Official headquarters will be in the Raleigh Hotel; registration in the United States Bureau of Mines; meetings in the Auditorium of the United States National Museum.

All persons expecting to attend the meeting are requested to notify F. F. Sharpless, secretary, Mining and Metallurgical Society of America, 52 Broadway, New York, as soon as possible. This is particularly important in the case of persons going from New York, in order that adequate sleeping-car accommodations may be provided.

Cyaniding in Closed Vessels

Recent discussion among cyanide metallurgists on the gold fields of South Africa has tended toward the saving of cyanide by carrying out the process in closed vessels. According to the *South African Mining Journal,* Sept. 25, 1915, in a paper presented to the Chemical, Metallurgical and Mining Society of South Africa by H. A. White, it was indicated that the average consumption of cyanide was 0.4 lb. per ton of ore treated, while zinc consumption was 0.32 lb. According to this, the annual requirement of sodium cyanide on the Rand is therefore about 5,000 tons, and it was said that, owing to its high price at the present time, any method of saving cyanide would be a distinct economy.

While efforts have been made recently to reduce the cyanide consumed, any actual reduction of consumption has been more than counterbalanced by a consequent loss of gold. H. M. Leslie believes that more definite beneficial results may be obtained through what he calls a "closed system" of cyanide treatment, which is in effect the carrying out of the process in closed vessels, so that there shall be no loss by evaporation.

Laboratory experiments have been carried out, and a considerable variety of information has been acquired, all of which tends to show that the loss by evaporation is great and that some steps should be taken to avoid it. Some authorities go even so far as to believe that the possible saving by using closed vessels may reach as much as 30% of the total now consumed. The matter will be further discussed, and a trial will be made to see just what can be done with the suggestion.

A New Flotation Experiment

SALT LAKE CORRESPONDENCE

A 25-ton experimental flotation plant employing the Fields process is being installed at the Ohio Copper Co.'s mill at Lark, under the direction of L. M. Walton, engineer for the Fields Electrical Flotation Co. This plant is being installed by John D. Fields and Irwin McNiece, who believe it will be of benefit to the General Exploration Co., now operating the Ohio Copper property under lease, and if it is successful a larger plant will be installed.

The recovery at the Ohio Copper mill has been only 64 or 65%, and if the Fields process is successful it will be used to treat the accumulated tailings, which include a 3,000,000-ton slime pile which carries about 0.8% copper. The 25-ton experimental plant is being installed in the western part of the mill, where it can cut in on any part of the feed. Experiments will be started first on the slime pile.

In a general way the process combines flotation and leaching and appears to be adapted to the handling of partly oxidized copper ores. Concentrates and electrolytic copper are produced. The crushed ore or tailings are placed in a cell with water to which a little sulphuric has been added, and agitated by air under 50 to 75 lb. pressure. Electric current, at from 10 to 25 volts and amperes depending on the size of the cell, is passed through the solution between copper electrodes. The current breaks down the water into hydrogen and oxygen, and these gases assist in the flotation of the sulphide particles, which are skimmed off. The oxidized portion of the ore is dissolved and deposited as electrolytic copper. The cost of treatment by this process, as indicated by experiments carried on at Maxville, Mont., on 1.57% copper ore, was approximately $1.25 per ton of material treated. A recovery of 92% was made. It is expected to have the experimental plant ready by the first or second week in December.

Canvass of Belgium's Metals

The Havas correspondent at Geneva, according to the New York *Times,* says that the German authorities at Ghent, Bruges, Mont. St. Amand, and Ledeberg have ordered by poster that all industrial establishments must declare how much copper, brass, and bronze they have, and in what forms. The directors of the industries are obliged to declare all old copper and extra pieces. The penalty for inexact or incomplete declarations is a fine of 20,000 marks, or imprisonment.

PERSONALS

Alfred Quimby, who is operating a gold mine in Guatemala, is visiting New York.

E. J. Collins, of Duluth, is in the Cobalt and Porcupine districts of Ontario on a trip of investigation.

Kirby Thomas has moved his office from 43 Exchange Place to Room 2744, No. 120 Broadway, New York.

Charles A. Banks, of the Jewel-Denero Mines, Ltd., and the Idaho-Alamo mines, both of British Columbia, is on his way to London.

Benjamin F. Tibby has opened a laboratory for microscopic analyses of rocks and ores at 419 Judge Building, Salt Lake City, Utah.

W. G. Norrie, mining engineer, lately of Vancouver, has been appointed manager of the Silver Standard mine at New Hazelton, British Columbia.

The Lehigh Portland Cement Co. announces the naming of Harold M. Scott as assistant secretary and the appointment of B. H. Rader as western sales manager.

E. Downie, president of the American Security and Investment Co. of Duluth, is in the Cobalt district in Ontario in reference to some projected operations there.

Charles W. Newton, general superintendent of the Consolidated Interstate Callahan Mining Co., Wallace, Idaho, was in Butte last week on business for the company.

J. G. McNulty returned to New York after several weeks spent examining pyrite deposits in Vermont, and has now gone to examine a copper property west of Sudbury.

Garnett Alfred Joslin, recently appointed mining engineer for the Ray Consolidated Copper Co., at Ray, Ariz., was married Nov. 9 to Miss Jessie E. Heber, of Los Angeles.

E. E. Kirkland, of Rome, Georgia, is opening a deposit of kaolin on his property near Lindale station. Several cars have been shipped recently and equipment will be installed.

Walter O. Snelling, formerly of Pittsburgh, Penn., has brought property in Long Island City, N. Y., on which he proposes building a large laboratory for chemical research.

W. W. Leck, superintendent of the merchant mill department of the Pennsylvania Steel Co.'s plant at Steelton, Penn., has been made superintendent of all the Steelton rolling mills.

R. J. Johnston, former assistant to the superintendent of the Donora plant of the American Steel and Wire Co. has been appointed superintendent of the zinc works of the company at Donora.

Frank L. Dalas, formerly chief electrician of the International Smelter Co., Miami, Ariz., has joined the electrical and mechanical department of the Youngstown Sheet and Tube Co., Youngstown, Ohio.

C. A. Buck, vice-president Bethlehem Steel Co., returned recently from Chile, where he has spent some months in the supervision of the new construction in connection with the company's Tofo iron mines.

Dr. S. J. Schofield, of Kingston, Ont., a graduate of Queens University and lately with the Canadian Geological Survey, has been appointed professor of geology and mineralogy in the University of British Columbia.

Gerald G. Dobbs, formerly chief engineer, ore mines and quarries, Southern District, Republic Iron and Steel Co., has been appointed superintendent of the Raimund Mining Division for the same company at Bessemer, Alabama.

E. V. Bray, vice-president A. L. Young Machinery Co., sailed from San Francisco on Nov. 20 for Celebes, Dutch East Indies, where he will design and construct a milling plant for the Minto concession of the Bolong Mongondou Company.

Alexander W. Behr, vice-president of the Russian-American Chamber of Commerce, Moscow, is now in this country in the interest of closer trade relations between Russia and the United States. His address is the Plaza, New York.

E. M. Hamilton, F. A. Beauchamp and S. E. Woodworth announce that they have become associated as metallurgical engineers under the firm name of Hamilton, Beauchamp, Woodworth, Inc., with offices and testing laboratory at 419 the Embarcadero, San Francisco, Calif.

J. D. Mooney, for several years in charge of the sales of the mechanical rubber goods division of the B. F. Goodrich Co., Akron, Ohio, has become associated with the Hyatt Roller Bearing Co., Harrison, N. J. Prior to Mr. Mooney's engineering-sales experience he was an associate editor of the "American Machinist."

C. H. Williams, former assistant superintendent of the Schoenberger steel works of the American Steel and Wire Co. at Pittsburgh, has been appointed assistant to the superintendent of the plant at Donora. He has been succeeded by William Pickford, formerly superintendent of the bessemer department of the Schoenberger works.

OBITUARY

Joseph G. Hendrickson died at his home in Philadelphia, Nov. 4, after a short illness, aged 69 years. He was the founder of the Ajax Metal Co., which was established in 1880. He retired as president of the company a little over a year ago, and since then has been chairman of the board, also chairman of the board of the Ajax Metal Co. of the South, Birmingham, Ala., and president of the Ajax Lead Coating Co. He was a member of the Union League of Philadelphia.

William Carmichael died at Biwabik, Minn., Nov. 12, aged 69 years. He was born in Scotland and came to this country when a boy with his parents, who settled at Bruce Mines in Canada. In 1869 he went to Minnesota, settling at Tower on the Vermilion range. When the Mesabi range was opened he went to Hibbing, having risen to be mine captain. He was superintendent of the Rust Mine near Hibbing for a time, but in 1897 went to Biwabik where he was superintendent of the Duluth and McKinley mines. Later the Oliver Iron Mining Co. added the Graham and Weed mines at Mesaba to his charge. He was considered one of the foremost mining men on the Mesabi.

SOCIETIES

Society of Chemical Industry—The regular meeting of the New York section was held at Rumford Hall, New York, Nov. 19. The subject for the evening was "Industrial Chemical Research" and the program included addresses by G. R. Fonda, C. F. Burgess, R. F. Bacon and W. H. Walker.

Mackay School of Mines—The second session of the Prospectors' Short Course at the Mackay School of Mines of the University of Nevada will be held from Jan. 30 to Feb. 26, 1916. The work of the course will include both lectures and laboratory exercises, and the subjects taken up will be prospecting, assaying, mineralogy, geology, prime movers, chemistry, hygiene, sanitation, first aid to the injured, and mining law. In addition to these regular courses there will be a number of special lectures upon subjects of interest to the prospector. In the short time available it will be impossible to cover in detail any of the subjects taught, but an attempt will be made to acquaint the members of the class with as many practical points connected with these subjects as possible. This course is designed primarily to aid the prospectors of Nevada, but is open to residents of other states. Those who desire to attend should present themselves at the office of the Registrar in Morrill Hall, Reno, Jan. 30, and register. No charges will be made for instruction, but a fee of $5 will be collected to cover in part the cost of supplies used during the course.

INDUSTRIAL NEWS

The American Car and Ship Hardware Manufacturing Co., general offices and works, New Castle, Penn., is making large additions to its present plant.

The Bayard Chemical Co. is equipping a plant at Edgar Station, Woodbridge, N. J., for the manufacture of phenol, salicylic acid and a general line of pharmaceutical chemicals. Post office address is Woodbridge, N. J.

E. E. White, agent of the Mass patent drill hole compass, announces that 12 of these compasses have been rented to prominent exploring companies and drill contractors in the United States, Canada and Russia and are proving very successful.

The Homestead Valve Manufacturing Co., Homestead, Penn., is manufacturing an angle-type blow-off valve, to be used in connection with its plug cock, where a double blow-off arrangement is desired on steam boiler blow-off lines. The body of the "Hovalco" valve is of semi-steel, and the seat and disk are made of Monel metal. The valve is designed for 250-lb. pressure in 1½ to 3-in. sizes and with screwed and flanged body.

Editorial Correspondence

SAN FRANCISCO—Nov. 17

The State Highway is Completed from Yreka to Hornbrook. The next advance will be to extend the road to the Oregon state line. Yreka is connected by a branch railroad to Montague, connecting with the Southern Pacific. The situation of Yreka in relation to the mining interests of the county is such that the mining men would be greatly benefited by good roads, in the building of which they should be aided by the State Highway Commission. The U. S. Steel Corporation is reported to be interested in manganese deposits near Sawyers Bar, but unless the wagon road from Etna to Forks of Salmon is widened and otherwise improved, or a new road is built following the trail to Orleans, there will be small prospect of developing the manganese. These improvements would permit transportation of ore by way of Etna and Yreka, or by Orleans to tidewater. But Siskiyou County and the wideawake towns should not wait for the Highway Commission to act in their behalf. The development of mines in Siskiyou County depends very largely upon good roads, and good roads depends very largely upon good citizens. Siskiyou County has the good citizens and should have the good roads.

The Dutch-Sweeney-App Mines in Tuolumne County, recently taken over by W. J. Loring, will be financed by American money, the Bewick, Moreing & Co. interests taking no part in the enterprise as a corporation or firm. Mr. Loring states that it is not at present possible to take British money out of the Empire and invest it in American mines or other enterprises without the consent of government. So he has interested Eastern investors in the exploration and development of this property. The three mines adjoin and for the sake of economical operation should have been worked under one management from the beginning of their productive period. The Dutch was developed into a good producer three or four years ago by C. H. Segerstrom, who installed modern machinery and extended development into the Sweeney ground. He got the property on a paying basis and would have undertaken to place the App on the same basis if he could have obtained the mine or secured control. Captain Nevills had numerous chances to sell the App, but about the time the proposed purchasers were ready to act the captain jumped the traces. He was a money-making miner and grew rich and was often broke. Always a hard man to deal with, the mine investors with the money and the ability to mine by modern methods concluded they would have to wait for Captain Nevills to die before undertaking to relieve him of the operation of paying mines which he was handling by early-day methods. Captain Nevills obliged them. He died, and the properties in Tuolumne and Amador Counties went into the hands of creditors. Then the chief creditor died. In the past year the Melones mine interests took over the Dutch-Sweeney, and it is probable the same interests would have considered the App in good time. Now that the three properties are in the hands of Mr. Loring, with Albert Burch in the position of manager for Bewick, Moreing & Co. interests in Amador and Eldorado Counties, the effect of British activity in the development of California gold mines will in a short time become quite evident, even if the company must now depend largely upon American investors. The showing made by the Plymouth Consolidated in Amador County under the management of Mr. Burch and the superintendency of Mr. Parks, and the active preparation at the Montezuma in Eldorado County and now the undertaking of the operation of these properties in Tuolumne County is proof enough that there is some inducement held out by the quality of the properties taken hold of. California has other mines that stand in the same need of money and men, and only await the application of modern methods to put them again in the producing class.

BUTTE—Nov. 18

The Montana Power Co. completed another of its many hydro installations. This time it is the Volta plant, situated 11 mi. northeast of Great Falls at the Big Falls of the Missouri River. This plant has a capacity of 90,000 hp., of which 61,600 hp. is now available. The plant will furnish the additional power required for the operation of the first division of the Milwaukee road and other large demands for power. The electrolytic refinery and other departments of the plant being installed by the Anaconda company at Great Falls will be ready for operation by Feb. 1, and a large amount of electric power will be needed there. The new equipment at the Washoe works at Anaconda is practically finished and the requirements there for additional power will likewise be large. Combined with the growth of the cities furnished with light and power by the Montana Power Co., this has made such an increase in the call for electric energy that all additions to the company power resources are practically taken in advance. The Volta plant is the largest of the company's hydro-electric plants. Its construction took three years. The equipment consists of four units of 15,000 hp. each and two smaller units of 800 hp. each, while provisions are made to bring the capacity of the plant up to 90,000 hp.

SALT LAKE CITY—Nov. 18

The Utah Iron and Steel Co., recently incorporated, has started operation at its plant at Midvale, and will supply iron and steel for building and manufacturing purposes. At present the plant is making round and square iron from ¼ in. to 4 in. in section, and flat material from 1x⅛ to 8x2 in. After the first of the year mine rails of 8, 12, 16, 18, 20, 25 and 30 lb. per yard will be manufactured. Other equipment will soon be installed, including an openhearth furnace. It is expected to manufacture structural angles for heavy construction. At present concrete-reinforcing bars are being made. C. W. Whitley is president. The properties and business formerly conducted by the Silver Bros. Iron Works Co. has been taken over by the Salt Lake Iron and Steel Co., which has assumed the obligations of the old company. The company announces that it is equipped to make nearly all kinds of iron, steel, brass and copper work, and asks to be allowed to bid on local iron and steel work, before orders are placed with eastern firms. A specialty is made of mining and especially designed machinery. O. C. Beebe is president.

Directors of the Utah Chapter of the American Mining Congress have passed a resolution, endorsing the resolutions of the Mining and Metallurgical Society of America, which has called a convention of mining men to be held in Washington, D. C., Dec. 16, for the purpose of urging upon Congress the necessity of revising the mineral-land laws affecting mining locations. Certain resolutions of the Mining and Metallurgical Society of America have been adopted by nearly unanimous vote and these the society will introduce at the meeting of Dec. 16. The subject is covered in the proceedings of the Society supplemental to Bulletin No. 87, Aug. 31, 1915, Volume 8, No. 8. Delegates of the Utah Chapter will be appointed for the purpose of presenting this resolution at the meeting on Dec. 16. The matter will also be taken up with Utah's Senators and Congressmen here with a view to getting them to take an active interest in the subject. The Secretary of the Mining and Metallurgical Society has been writing to the officials of mining companies here in Utah urging them to attend this convention or send representatives. R. C. Gemmell, governor of the Utah Chapter of the American Mining Congress, in a letter Nov. 16, to officials of Utah mining companies, outlining the above, says, he "realizes it is difficult for many of us here to get away for a trip of that kind, and therefore would respectfully suggest that if you cannot go yourself, you take the matter up with the officers of your company in the east, recommending that they send a representative of your company to the meeting." Mr. Gemmell states he has made such a suggestion to the New York officers of the Utah Copper Co. and adds that the meeting is a very important one and as many mining companies as possible should be represented.

WALLACE, IDAHO—Nov. 12

The Passing of the Ray-Jefferson into the control of the Days, reference to which is made in The Mining News of this issue, is a matter of deeper significance than appears on the surface. Prior to the meeting of the stockholders of the Ray-Jefferson in this city on Nov. 6, J. B. Beaty, secretary of and acting for the Consolidated Interstate-Callahan Co., who is also attorney for the American Metals Co., had offered 55c. per share for all or for a majority of the stock of the company, 1,500,000 shares, being on a basis of $825,000 for

the property, and it is learned from reliable sources that this offer was raised to practically a million when the stockholders met for the purpose of adding 500,000 shares to the capital stock of the company. This offer was met by Harry L. and Eugene R. Day, managers of the Federal and Hercules companies, respectively, both of whom were at the meeting, with the announcement that they stood ready to duplicate any offer that was made for any amount of the stock, and that as they had undertaken to finance the company, they felt that they should be given the preference by any stockholders who desired to sell. This talk won; the Interstate-Callahan offer was turned down, and the meeting proceeded to increase its capitalization by 500,000 shares which were turned over to the Days for their financial support and which gave them the control of the company. The Ray-Jefferson joins the Interstate-Callahan on the west and the development of both properties leads to no other conclusion than that the great orebodies of the latter extend into the former. The original Callahan ground lies next to the Ray-Jefferson. Reverting to the controversy within the Interstate-Callahan company over the appointment of a receiver and for the control of the company, which will engage the attention of the federal court at Coeur d'Alene the coming week, it will not be difficult to discover a motive for the control of the Ray-Jefferson outside of the actual value of the property. Since the appointment as receiver of the Interstate-Callahan by the state court, of Eugene R. Day, who is awaiting action by the federal court before taking charge of the property, the impression has grown that the ultimate purpose of the Callahan faction, which is trying to wrest control, is to dissolve the Consolidated company and combine the original Callahan property with the Ray-Jefferson. The receiver was already a large stockholder in Ray-Jefferson, had already guaranteed large financial support and the actual control of the property by him and his associates was clearly foreseen. That the Interstate-Callahan company believed this to be the purpose is plainly indicated by its eagerness to secure the Ray-Jefferson at almost any price, and it is equally evident that the Days, in meeting any offer, regarded it as essential to consummating their plans. In contending for the removal of the receiver in the federal court, it is expected that this phase of the case will be given much attention, in connection with the splendid financial condition of the Interstate-Callahan company, as showing that there was no valid ground for the application for a receiver and that it was not made in the interest of the stockholders of the company.

DEADWOOD, S. D.—Nov. 11

Lithium Ore is being Produced at three mines in the Keystone district, and several others are yielding these ores intermittently. The principal producing mines at present are the Hugo and Peerless, operated by H. Reinbold and the Bob Ingersoll, owned by C. H. Kamman. Amblygonite is the principal ore mined; it averages about 7% lithium and is worth $38 per ton, f.o.b. the Atlantic Seaboard, which is equivalent to about $28 a ton f.o.b. Keystone.

Wolframite is Being Produced on a large scale at the Wasp No. 2. Since the first of the year the production of ore, hand-sorted, averaging nearly 50% tungstic acid, has brought on the market over $100,000. Several hundred tons of medium-grade ore has been piled on the dump awaiting the construction of the contemplated concentrating unit of about 25 tons daily capacity. T. J. McGowan is taking out ore which will be shipped to McNish and Mills for concentration. The Black Hill Tungsten Co. is preparing to resume work in both mine and mill. Tungsten ores are also attracting attention around Hill City, where within the last few weeks, more than 50 locations have been filed on tungsten outcrops.

MORENCI, ARIZ.—Nov. 19

The Unionists Are Jealous of the Duncan tent colony, which is being added to by about 30 strike deserters daily. Although Gutierrez de Lara, organizer, denies the report that he advised the strikers, in public address, to consider means of breaking up the colony, he says that Duncan is the place for those who cannot distinguish between right and wrong; and that if supplication will not avail to bring them to a proper state of mind, a little physical force might turn the trick. The strike will be fought to a finish. Now is the time to "teach the mining companies their lesson" and to "stop, once and for all, assaults on organized labor." Everybody coming in is halted by strikers at the depot and his identity and business ascertained. The deputy sheriffs look on, or perhaps vouch for the "neutrality" of the visitor. Only 65 troops are still enjoying their outing here. Sunday train service between Morenci and Guthrie, Morenci So. Ry., and Sunday passenger service between Clifton and Hachita, N. M., A. & N. M. Ry., have been discontinued.

OATMAN, ARIZ.—Nov. 19

The Oatman District, which is enjoying such a substantial boom just now, is reached by wagon or automobile from Kingman, Ariz., about 25 mi. northeast, or about 12 mi. northeast from Needles, Calif. Both points are on the Santa Fé. The old camp of Oatman is situated on rolling foot hills 10 mi. east of the Colorado River and is surrounded by mountains on the north, east and south sides. The population has increased from about 500, six months ago, to about 2,000 at present, and the dwellings now being erected have a look of permanency. The town enjoys a newspaper, ice plant, running water and other luxuries. Several properties in the district have changed hands recently, and much development work is being done. According to reports, there are any number of orebodies of all sizes and descriptions, assaying from $20 to $1,200 per ton. The Gold Roads mine, U. S. Smelting Co., ships about $65,000 gold bullion monthly, and the United Eastern has ore blocked out to the value of 8 or 10 million dollars. A few days ago the James mill at Secret Pass sent to Kingman a gold bar valued by the bank at about $850, the cleanup of only 105 hrs. run. The new slogan throughout the county is that "The greatest knocker in Mohave County is opportunity."

COBALT, ONT.—Nov. 20

Local Agitation for Coinage of a Small Cobalt Coin of 5c. denomination for Canadian circulation is being pushed, and some hope that England may also be induced to come into line on this financial innovation. It is argued that cobalt is as available for coins as nickel and it is hoped to have in circulation a distinctively Canadian coin which will be designated in the vernacular a "cobalt" in emulation of the ubiquitous and nimble American "nickel." Also there is the local motive of enlarging the market and uses for cobalt which is distinctively a Canadian product and which is found there in such superabundance.

The Future of the Silver Market is an ever present subject of discussion in this camp. When the war began all the "wise ones" predicted a rise in silver. Various reasons were advanced and high authorities were quoted to back the arguments. In fact, managements of the companies in the financial centers seemed to be of the same opinion as the local "wise ones," for several of the companies made arrangements to hold all silver for the expected great and immediate rise. After more than a year of very low market the "bull" argument is again to the front with the same reasons and some others based on the real or imagined financial status of the world as affected by the present prodigious expenditures of Europe. It is argued that Europe must go on a silver basis in order to meet the extraordinary conditions which have arisen or are likely to result from the war. The optimists have the floor for the time and the good behavior of the silver market for several weeks aids them. To the outsider the great concern about silver can be understood better than sympathized with. This camp produces silver for from 10c. to 25c. an ounce and while the extra cent or two on the selling price is interesting, it is not vital to the present or immediate future of the mining industry of Cobalt. Several of the strong companies have for some time been storing silver in the banks against the expected rise, which has resulted in a growing dissatisfaction among the stockholders who claim that the small gain so far evidenced is hardly an offset for the loss in interest, and anyway they would like their money for present opportunities. Already letters of protest are being sent to the managements by large stockholders. It remains to be seen whether the "wise ones" are as right now marketwise as they were a year ago. No doubt a strong rise in silver would result in a greatly enlarged production from the camp, for it is known that several of the large companies are not now pushing output to the limit and in fact recently several of them have curtailed mining operations presumably in hopes of a better market at some future time.

BALFATE (VIA TRUJILLO), HONDURAS—Nov. 8

The Discovery of Asphalt in Honduras, near Jutigalpa, was mentioned in a recent number of the "Journal," giving it as tributary to Amapalla as an outlet for the product, etc. As a matter of fact, it is tributary to Trujillo, on account of the shorter distance—approximately 180 mi. with a standard gauge railroad being built and well under way by the Truxillo R.R. Co., (Truxillo and Trujillo are one thing), which is heavily financed; Jutigalpa being the objective point, with Trujillo as the ocean terminal. This will open a rich mineral country, chiefly gold and copper; the latter exists in veins with vertical exposures in creek cañons of from 10 to 45 ft., and is rich ore, some assaying 42% copper with a gold content of $800 per ton. Some have been worked in a crude way. Most of the church bells in Olancho were cast with metal from this ore.

The Mining News

ARIZONA

Gila County

OLD DOMINION (Globe)—Production of Old Dominion smeltery for October was 2,700,000 lb. of copper, an increase of 400,000 lb. over September. Concentrator is handling daily about 100 tons of ore from Arizona Commercial and about 600 tons from other sources. Old Dominion mine is producing 900 to 1,000 tons of ore per day, and pumps are handling 5,000,000 gal. of water daily. The unwatering of Big Johnnie shaft is progressing satisfactorily.

Mohave County

LEXINGTON (Kingman)—Sinking of three-compartment shaft at Lexington mines to depth of 600 ft. will be started soon. Cross-cutting will begin at 600-ft. level.

Pima County

NEW CORNELIA COPPER (Ajo)—New railroad from mine at Ajo to Southern Pacific R.R. at Gila Bend will be completed Jan. 15.

Yavapai County

BAUMANN (Prescott)—Stockholders of Baumann Mines Co., St. Paul, Minn., men, contemplate extensive campaign of development work at mines. One-mile wagon road now being built to property.

PITTSBURGH (Briggs)—Work of developing Pittsburgh mine, situated on Castle Creek near Briggs, has been resumed by C. E. Champie. Has large quantity of rich ore blocked out and will soon begin making regular shipments.

ARKANSAS

Sebastian County

A NATURAL GAS WELL, sunk at Fort Smith, Ark., by Harry Kelly, at 2,300 ft., is yielding 15,000,000 cu.ft. of gas per day.

CALIFORNIA

Amador County

ZEILA (Jackson)—Reported that Kennedy Mining Co., which recently purchased this mine, will sink a new shaft for development and operation of orebody disclosed about year ago.

PLYMOUTH CONSOLIDATED (Plymouth)—Report of W. J. Loring, representing Bewick Moreing & Co., states that company expended $830,000 in development and installation up to time milling of ore began. Form Aug. 1, 1914, to Oct. 1, 1915, gross production has been $686,074; surplus over all expenses being $218,030. Mine is equipped with 30 stamps but only 25 have operated. In period named 141,623 tons of ore were treated; average duty per stamp at present time is about 11 tons, and recovery, fraction under 90%. Total cost including development has run from $6,000 to $9,000 per month, making per ton cost under $2.90.

Butte County

ZENITH IRON (Forbestown)—Reported that men representing U. S. Steel Corporation have undertaken development of this iron and chrome deposit. Ore is being hauled to Oroville by motor truck and shipped to Pennsylvania by Western Pacific.

WHITLOCK (Chico)—Shipment of 22 tons of sacked ore to Selby first ore shipment from Chico for several years. Mine is situated on Butte Creek; owned by Frank Whitlock, K. D. Crowder and others. Ore hauled distance of about 15 mi. to Chico in motor trucks.

Calaveras County

CALAVERAS COPPER (Copperopolis)—On No. 4 level 15-ft. body of ore in hanging wall reported to assay more than 8% copper. Besides ore going to concentrator, some shipments are being made.

GREEN MOUNTAIN (Angels Camp)—J. B. McGuire and J. Ivers operating under lease on this gravel mine in Chili Gulch are taking out pillars left in old workings and receiving good returns. Some of gravel yielded at rate of $50 per car. Gold is coarse.

Eldorado County

EUREKA SLATE (Placerville)—W. J. Dingee reported to have installation of new machinery near completion. Old machinery is being overhauled and tested aërial tramway has been repaired and will be extended to railroad. Production of slate is expected to be resumed soon.

Inyo County

CUSTER (Darwin)—J. H. Thorndike has resumed work. The shaft is being straightened and preparations are being made for active development.

DARWIN DEVELOPMENT CO. (Darwin)—Knox 10-ton tractor has been received and will be used in hauling the ore 24 mi. to Keeler, nearest railroad shipping point. Company is operating under lease and purchase option.

Kern County

GENERAL PETROLEUM (Taft)—New pipe line in north Midway in course of construction, with 100 men employed and 100 to be added as soon as work is in shape to handle them. Pipe line will be 26 mi. long.

YELLOW ASTER (Randsburg)—Both mills, with total of 130 stamps, crushing about 300 tons of ore per day. Earnings for first eight months of 1915 totaled $305,584. Total costs of operation, $199,068; surplus, $106,516; dividends for period, $11,000.

Monterey County

PATRIQUEN (Parkfield)—Small retort being operated, producing 20 flasks of quicksilver per month. Shipments go out by way of San Miguela.

San Bernardino County

TRONA POTASH (Trona)—Large amount of machinery received and new surface buildings erected preparatory to increasing operations at Searles Lake. Refining plant at San Pedro near Los Angeles will be installed.

Shasta County

MENZEL (Redding)—A. Meagher and Frank D. Barbet are reopening this mine on Flat Creek and have 200 tons of ore ready for shipment to Mammoth smeltery at Kennett.

MAMMOTH (Kennett)—A 2-unit zinc-oxide plant is being installed to be operated in conjunction with baghouse, in further reducing fumes. Drill sharpeners are being installed at Sutro and Friday-Lowden. An air-pipe line is being laid from Mammoth compressors to Friday-Lowden, distance of 4,000 ft. Tunnel to be driven from this point will tap Mammoth 500 ft. below present No. 5 tunnel, which is main working level.

Tuolumne County

DUTCH-SWEENEY and APP (Jamestown)—W. J. Loring, principal partner of Bewick Moreing & Co., has interested American investors and taken over these 3 mines. Dutch-Sweeney was recently acquired by Melones interests, and App has been idle for about 2 years, being closed down prior to death of Capt. Nevills, original owner.

COLORADO

Clear Creek County

PRODUCTION DURING THE MONTH OF OCTOBER from the mines adjacent to Idaho Springs amounted to $48,200. Of this amount, $30,200 is represented by 87 carloads, or 2,175 tons averaging $14 a ton, shipped through the Chamberlain Ore Co. The balance of $18,000, is represented by bullion from the Argo mill to the Mint at Denver. The production is about $2,560 or 5½% more than for the same month last year.

CAPITAL MINING AND TUNNEL (Georgetown) — Adit which is being advanced on Aetna vein has opened 12-in. vein of high-grade ore, assaying 1 oz. gold, 40 oz. silver and 25% lead.

GEORGETOWN TUNNEL AND MINING (Georgetown)—This development tunnel is to be advanced an additional 100 ft. under contract awarded to Chas. Jones and Edward Wing. John Keating, of Georgetown is manager.

ALMADEN MINES CO. (Idaho Springs)—Entire property of this company, situated in Lower Fall River Mining District, has been sold to satisfy judgment amounting to $27,620. Property was purchased by George Neill, of Topeka, Kan., and J. A. Greenfield, of Bellaire, Ohio. Active development of mines will be resumed in near future.

Denver County

WESTERN CHEMICAL (Denver)—Continues to make large expenditures for increasing its manufacturing capacity. Business has increased markedly since withdrawal of competition by eastern manufacturers who are filling war orders. This company now sells more than 1,500 tons of sulphuric acid per month; product being derived from complex Colorado sulphide ores that are purchased at an average price of $12 per ton.

Teller County

REQUA SAVAGE GOLD MINING CO. (Cripple Creek)—This is new incorporation organized to take over holdings of old company of same name. Directors for first year are J. S. Guyer, Jas. Yeomans, Albert Schumacher, J. T. Hawkins and Sarah Finegan. Property is located on eastern slope of Beacon Hill adjoining Gold Dollar, St. Thomas, Commonwealth and Little Nell properties. Campaign of development is under advisement.

SHOO FLY (Cripple Creek)—This property on southwestern slope of Womack Hill is being developed under lease by Hickman & Co. Old discovery shaft has been cleaned out and will be sunk to depth of 100 ft. Rich surface discovery, which was made about 50 ft. north of the shaft, will be developed through new shaft. Recent sampling of vein indicates high-grade ore. A 2½-ft. streak assays over 9 oz. gold for distance of 15 ft. along vein. Screenings from ore produced from surface openings assay 15 oz. gold. Western extension of Shoo Fly vein has been opened in Iowana property. Ground is included in Block 160 of Stratton Estate.

JERRY JOHNSON (Cripple Creek) — Property is being operated from 650-ft. level to surface by Caley Leasing Co. which is performing active development. Caley mill has been started and it is estimated that available low-grade ore in mine will keep plant busy for four or five years. Rich strikes have recently been made on 160-ft. and 550-ft. levels. Concentrates from mill are averaging about $28 a ton. Mine is being actively developed on 850-ft. level by Cripple Creek Deep Leasing Co. which controls ground below the 650-ft. level. Payable ore has been opened in new development. Since commencing operations this company has completed 275 ft. of crosscutting and drifting. Another crosscut will be started on 950-ft. level.

IDAHO

Shoshone County

NATIONAL COPPER (Mullan)—Mill started Nov. 11, after much delay in getting equipment. It is reported that bins hold 12,000 tons of ore and mine is in condition to keep mill going at capacity, 500 tons, per day. Recent development has disclosed better grade of ore in drift from bottom 200-ft. shaft and also in upper workings, improvement being in both copper and silver.

COEUR D'ALENE ANTIMONY (Kellogg)—This company which took over old antimony property at mouth of Pine Creek is building mill, frame work of which is almost completed and much machinery on ground. Shipped one car that averaged 36% antimony and second car is in transit. Much ore in sight in mine, one shoot being 80 ft. long and 4 ft. wide. All ore will be milled and it is expected that shipping product of not less than 50% will be turned out.

COLONIAL MINING CO. (Kellogg)—Company, of which Watson and J. D. Beebe are controlling factors, was recently organized to take over Little Pittsburg property on Pine Creek. Contract let to Union Iron Works of Spokane for tram 1½ mi. long to deliver ore at base of hill; tram is to be completed in 5 weeks. Ore will be hauled by team from end of tram to railway station, 7 mi. Company has ordered machinery for sorting plant and expects to ship 30 cars monthly of crude zinc ore.

RAY-JEFFERSON (Wallace)—Meeting of stockholders Nov. 6 increased capital stock from 1,500,000 shares, par value of 25c., to 2,000,000 same par. Additional stock taken by Harry L. and Eugene R. Day, manager of the Federal and Hercules companies, respectively, and gives them, with their former holdings, 950,000 shares, or practical control. Mill will be built on Beaver creek early in spring, and it is regarded as certain that railroad will be built from North Fork branch of the O.-W. R. & N. to Ray-Jefferson, distance of about 10 mi. Company owns 32 claims and large ore shoots have been developed on two veins, both lead and zinc.

INTERSTATE-CALLAHAN (Wallace)—Report of John A. Percival, president of the Interstate-Callahan company, for quarter ended Sept. 30, 1915, has been made public. Total receipts were $1,049,478; operating costs totaled $162,351 and improvements $23,935, leaving operating profit of $863,192. Tonnage mined was 29,021; shipments of crude ore and concentrate aggregated 15,443 tons—ratio of run-of-mine ore to shipping product of 1.879 to 1. Of crude lead ore 203 tons was shipped, assaying 19.54 oz. silver and 40.68% lead; of crude zinc ore, 2,506 tons, 49.01% zinc. Ore milled totaled 24,595 tons, 28.5% zinc. Concentrates produced were: Lead, 792 tons, 23.86 oz. silver, 53.33% lead; zinc, 11,942 tons, 48.06% zinc. Ratio of milling ore to total concentrates was 1.93 to 1. Total cost per ton of ore mined was $5.495, of which $3.389 represents cost of mining and $2.106 the cost of treating and shipping.

MICHIGAN

Copper

CALUMET & HECLA (Calumet)—Shipments of silver to United States Mint increasing steadily. The amount this month was $27,000.

NEW ARCADIAN (Houghton)—Third mill test showed 34 lb. of mineral per ton in 1,132 tons of rock. Showing is quite as good as two previous tests.

NEW BALTIC (Houghton)—Has operations well under way to reach Arcadian lode. Treasury is amply supplied with funds, $60,000 in all when last assessment is fully paid.

WHITE PINE (Ontonagon)—In addition to copper is finding considerable silver and some gold in its recoveries. Another important development is the realization that the shale carries commercial copper. When this property first opened and for the first few years of its underground opening work greatest difficulty was narrowness of rich standstone vein, bounded by shale. Shale does not run as high as sandstone in copper, but it does give a width of 30 ft. of profitable vein matter.

MINNESOTA

Cuyuna Range

ROWLEY (Barrows)—Electric pump installed and sinking will shortly be resumed.

CUYUNA-DULUTH (Ironton)—After idleness of over a year this company's Ironton shaft will shortly resume operations.

CRAFT (Crosby)—Drifting is progressing but no production will be shipped this season. The 40-acre tract immediately east of Craft has been optioned for lease on a 25c. royalty and 20,000-ton minimum. Grantees in transaction are not named.

CUYUNA-SULTANA (Ironton)—Soo Line now laying steel on spur to mine. If same is completed before navigation closes, the 6000-ton stockpile of manganiferous ore will be shipped. Daily production 200 tons. Mine and concentrator will be operated all winter.

Mesabi Range

LA RUE (Nashwauk)—Washing plant being thoroughly overhauled. It is planned to increase production to 300,000 tons next season.

Vermilion Range

SOUDAN (Tower)—Concrete foundations being laid for new steel shaft house, superseding present wooden one.

MISSOURI-KANSAS

NEW CENTURY (Galena, Kan.)—Has started up again after being shut down for few weeks making some improvements in plant. Installed new set of sludge tables to help handle slime that comes from fine sand in overflow from steam jigs, which formerly was carried off by water to supply pond. Is one of best equipped plants in district.

J. M. SHORT (Joplin, Mo.)—Has made an exceptionally good strike on his 10-acre lease on Banker land southeast of Joplin. At 145 ft. struck ore which assayed 29% zinc. Ore continues down to 165 level where it assays 19%, with same grade of ore in bottom of shaft. Will drill another hole or two and if they prove as good as first one, will build new plant to handle ore.

GRAND TOWER (Joplin, Mo.)—To build new concentrating plant on lease of 10 acres southwest of town. Plant will be 150 tons' capacity; run by electric power. Ground was worked several years ago, but shaft and ground caved in and ground was abandoned. New company has sunk new shaft; struck first ore at 65 ft. which continued down to 90-ft. level, giving 25-ft. face of good ore which assays from 10 to 20%.

MONTANA

Dawson County

NATURAL GAS NEAR GLENDIVE—It is reported that natural gas in commercial quantities was struck Nov. 17 in well, 11 mi. southwest of Glendive. Drill was sent to depth of 751 ft. and flow of gas showed pressure of 400 lbs. per sq.in. Two other wells will be drilled at once and gas piped to city where a franchise for its use has already been awarded.

Jefferson County

BOULDER MINING DISTRICT—Doctor Ironside, of Butte, who owns Shield property, 12 miles south of Boulder on Little Boulder River, is building concentrator. He has put up sawmill near mine to cut timber for mine and mill; expects to complete mill next spring. There is said to be fine showing of ore containing copper, silver and gold. Forty men are employed at property at present.

Lewis and Clark County

UNIONVILLE MINING DISTRICT—Reported that rich strike of gold quartz has just been made in an old tunnel at mouth of Arrastra gulch. Vein is declared to be 7 or 8 ft. wide and the ore to be free milling carrying from $50 to $75 of gold per ton. Mine is located 3 mi. above road to Unionville in neighborhood of East Spring Hill properties. Strike was made while doing assessment work.

Missoula County

RICHMOND (Saltese)—Shipments average one car of ore a week to British Columbia smelters. Ore carries 8 to 29% copper and $4 to $8 in gold. Construction of aërial tram postponed and wagon road is being built from Adair, 3 mi. from mine. Ore is now shipped by way of Saltese, 6 mi. from mine.

Silver Bow County

NORTH BUTTE (Butte)—Widows of eight of the 16 victims of the explosion at Granite Mountain shaft which occurred Oct. 19, applied for lump sum settlements of $4,000 each when they appeared before E. A. Spriggs, chairman of state accident board, at meeting held in Butte Nov. 11 to determine compensation. Board hesitates about giving lump sums because few of these women have had business experience, and it would defeat purposes of act for them to lose their compensation in short time Compensation in all will amount close to $75,000. Injured men will not receive full compensation until their injuries are determined. In meantime they will receive $10 a week.

NEVADA

Mineral County

LUCKY BOY (Hawthorne)—A 600-ft. tunnel completed recently for haulageway and drainage. Upper workings 300 ft. above face of tunnel which is 1,200 ft. below original Lucky Boy shaft collar. Several leasers are working around 800-ft. level.

Nye County

TONOPAH ORE PRODUCTION for week ended Nov. 13 amounted to 9,189 tons, estimated value $191,362, compared with 10,343 tons week previous. The producers were: Tonopah Belmont, 2,887 tons; Tonopah Mining, 2,350; Tonopah Extension, 1,850; West End, 609; Jim Butler, 1,100; Halifax, 70; North Star, 53; and miscellaneous leasers, 370 tons.

Storey County

SIERRA NEVADA (Virginia)—Development on vein 2,500 level disclosed low-grade ore; 68 tons of ore saved averaging $11.42 per ton.

ANDES (Virginia)—Saved 15 cars of ore from stope above 175 level. Repairs to 350 level connecting with 250 level of Central has been started.

OPHIR (Virginia)—In Central tunnel 250 level disclosed 7 ft. good milling ore. Saved 359 cars of ore from stopes above north and south drifts; milled 312 tons.

MEXICAN (Virginia)—Sampling in west crosscut on 2,500 level and prospecting on 2,700 level. Winze on 2,700 level shows 3 ft. of vein matter in bottom; selected samples assay $50 per ton.

CROWN POINT-BELCHER (Gold Hill)—Saved 153 tons of mill rock from sill floor; north drift reopened to 130-ft. point; 86 cars mill rock saved: Jacket mill received 878 tons of dump rock and shipped bar of bullion.

UNION CONSOLIDATED (Virginia)—Extracted 105 tons of ore averaging $26.32 from south end of No. 3 stope on 2,500 level, and 56 cars of low grade in making room for timbers. Saved 50 tons of ore averaging $18.40 from raise in No. 1 stope. Top of raise in ore sampling $20 per ton.

NEW MEXICO

Grant County

J. T. OGLESBY (Pinos Altos)—Has arranged to finance custom mill for district. Plant will be erected on old Bell & Stephens mill site.

Lincoln County

WILD CAT LEASING (White Oaks)—North and South Homestake mines of the Wild Cat Leasing Co., and Old Abe mine, mills and water rights, also Miner's Cabin and Silver Cliff mines, were sold last week to Richard Wightman and associates, of New York, for $250,000. Edward Queen, formerly of the Wild Cat Leasing Co., will have charge of the properties. The new company will rush mining of tungsten ore, of which a carload was recently shipped that netted over $19,000.

PENNSYLVANIA

Allegheny County

PENNSYLVANIA SMELTING (Carnegie)—Day interests, identified with purchase of old smeltery at Northport, Wash., have announced purchase of refinery at Carnegie from Pennsylvania Smelting Co., and state that its capacity will be increased to take care of output of Northport plant.

SOUTH DAKOTA

Lawrence County

RATTLESNAKE JACK (Galena)—A chute of high-grade ore was encountered in the main workings Two Wilfley tables are being installed in the mill and as soon as the Oliver filter is added the plant will resume operations.

Pennington County

BIG HIT (Keystone)—Shaft being unwatered and property undergoing repair for active development work.

INGERSOLL (Keystone)—Regular weekly shipments of a carload of spodumene are being made to the East.

COLUMBIA (Keystone)—At this property, financed by Supt. R. Blackstone, of Homestake Mining Co., shaft is to be sunk to the 200-ft mark, where further lateral work will be done New shaft is 325 ft. from old shaft, which produced $100 ore. New shaft has disclosed ore; also found in crosscut on 100-ft. level.

TEXAS

Culberson County

HAZEL (Van Horn)—Is now being worked by Steele-Sutton-Steele Co., of Dallas. Last car shipped netted $125 per ton in silver and copper.

PECOS (Van Horn)—Which has been shipping copper ore for last six months, has been leased by P. B. Walker and associates, of El Paso and Mexico. They will start regular development at once and will sink 120-ft. shaft to depth of 200 ft., where they expect to find silver ore.

UTAH

Beaver County

CROFF (Milford)—Fifteen inches of silver-lead ore has been opened in bottom of Lucky Boy shaft, at this property in Lincoln mining district.

MOSCOW (Milford)—New electric hoist has been shipped and should be installed shortly. Cullen shaft is to be sunk 300 ft. deeper from 800 to the 1,100 level.

DAVIS LEASE (Beaver City)—A 30-ton mill test is being made on second-class ore from this lease at Fortuna. Ore is being hauled 10 mi. to Sheep Rock mill to be treated.

FORTUNA GOLD QUEEN (Beaver City)—Work at this property has been started under direction of R. N. Strickland. Material has been delivered for erection of mine buildings, etc.

LUMLEY & MOORE (Beaver City)—Joe Davis lease has opened ore running well in gold. Five and a half feet are exposed. Harris & McGillis lease on parallel vein has opened 12 ft. of ore.

MAJESTIC (Milford)—Last car shipped by this company from its Old Hickory mine in Rocky district, carried 3.85% copper and 2.2 oz. silver per ton. Work is being done from bottom of large open cut. Vein is 20 ft. wide.

Juab County

UTAH POWER AND LIGHT CO.'S CONSTRUCTION WORK on new substation, owned jointly by Eagle & Blue Bell and Chief Consolidated, is well under way. The transformers have arrived. An automatic voltage regulator is being installed.

EAGLE & BLUE BELL (Eureka)—Foundations for new 250-hp. hoist have been laid, and gallows frame is nearly finished. Much of electrical equipment has been delivered, and is being installed.

YANKEE CONSOLIDATED (Eureka)—Shipments from new strike have been started; these are high in silver. New tunnel is being driven to tap ore at greater depth, which will facilitate handling and allow for disposal of waste. About 125 ft. of work will be necessary to make connections with winze. New work has been started in southeastern part of ground where tunnel is being driven in search of Beck Tunnel vein. Shipments of high-grade zinc ore from old stopes being made by leasers.

Salt Lake County

WORK IN BIG COTTONWOOD is being done at the following properties: Reed's Peak, five men; Branborg, three men; East Carbonate, three men; Big Cottonwood Consolidated, five men; Tar Baby, four men; Price Mining, six men; Monte Cristo, six men; American Consolidated Copper, six men; Kennebec, three men; Cardiff, 115 men; Last Chance, two men; Thor & Venus, two men; total, 160 miners.

ALTA CONSOLIDATED (Alta)—Drifting has been started at 100-ft. point in winze sunk on Braine fissure.

PRICE MINING (Salt Lake)—Tunnel is in 120 ft., and still in heavy ground. Spiling and timbering is necessary. Property adjoins Cardiff in south fork of Big Cottonwood.

UTAH COPPER (Bingham)—Up to 30,000 and 31,000 tons of ore are being mined and milled daily. Of this Magna mill is handling about 20,000 tons and Arthur between 10,000 and 11,000 tons.

SELLS (Alta)—Ore has been opened from raise 70 ft. above tunnel level. This is thought to be downward extension of Skipper fissure, which produced ore from surface workings. Sells is being operated by A. O. Jacobson and associates, through main tunnel of South Hecla.

ALBION (Alta)—Eight carloads of silver-lead-copper ore, carrying gold, have been shipped by leasers since the middle of October. This comes from old Wellington workings. Ore occurs in strong vein 4 to 5 ft. between walls. Royalties from leasers are sufficient to pay operating and development expenses of company.

NEW ENGLAND GOLD AND COPPER (Bingham)—Suit has been filed in third district court by International Trust Co., of Boston, asking for receiver and foreclosure on this company's property. Action is based on default in interest on $390,000 bonds. Trust company, as trustee of mortgage and trust deed, has been requested by bondholders representing $373,300 to file action and bring about foreclosure. Interest due Feb. 1, 1914, was not paid; interest to date amounts to $46,800. Property consists of seven claims in south branch of Carr Fork, and adjoins Utah Copper and Last Chance claims. Recently operations have been carried on by leasers only.

Summit County

PARK CITY ORE SHIPMENTS for week ended Nov. 11 amounted to 2,156,224 lb. by four shippers. Heavy storms have interfered with ore hauling.

SILVER KING COALITION (Park City)—Working forces now amount to 300 men at mine and mill, as compared to 370 men before strike. Reorganization of force is in progress.

BIG FOUR EXPLORATION (Park City)—New mill at Atkinson is treating 250 tons of old tailing dumps daily. Plant is now in good running order, and efficiency has been greatly increased. Concentrates carrying up to 40% zinc being made.

VIRGINIA

Augusta County

CRIMORA MANGANESE CORPORATION (Crimora)—Has contracted with Ruggles-Coles Engineering Co., New York, for first unit of its new washing plant, which is to have capacity of 100 tons of washed ore in 10 hr. Mill will comprise Kennedy slugger-roll crusher, McLanahan-Stone log-washers and jigs and Stephens-Adamson conveyors and transmission machinery. Foundations are in and it is expected that mill will be ready in January. It is proposed to mine with Schofield-Burkett dragline excavators. W. L. Hogg, manager.

WASHINGTON

Stevens County

UNITED COPPER (Chewelah)—United Copper mine, 60 mi. north of Spokane, earned $4,423 net in September, according to official report of directors. Report states that profits for October will be considerably larger, as mine and mill were working at greatly reduced capacity in September; it is estimated that November earnings will be between $25,000 and $35,000. Mill has been increased by addition of 50 stamps, making 74 in all; plant now is operating at capacity, 235 tons of ore daily. "During the early months of the year we were endeavoring to adapt the new oil flotation process to saving the values from our concentrates," states President Conrad Wolfle, of Spokane. "This entailed considerable experimental work and necessitated tearing out our slime tables and installing the tanks and cells of the new system, as well as making exhaustive tests to ascertain the proper kind of oil required for our sulphide ores. It took some time to get the process down to a profitable working basis, but for several months our saving has ranged from 77 to 80%, which is as good as is being secured by any other plant in the northwest from a similar class of ore. The percentage of saving is being increased continually by further tests and improvements to the process."

CANADA

Ontario

ORE SHIPMENTS OVER THE T. & N. O. Ry., for October, were from: Cobalt proper, Beaver, 30 tons; Buffalo, 92; Cobalt Comet, 63; Coniagas, 32; Crown Reserve, 99; Kerr Lake, 57; La Rose, 37; McKinley-Darragh, 81; Mining Corporation of Canada, Cobalt Lake Mine, 216; Townsite City, 202; Nipissing, 103; Penn Canadian, 31; Peterson Lake, 141; Right of Way, 38; Temiskaming, 31; total, 1,311 tons; from New Liskeard, Casey Cobalt, 29; from Elk Lake, Miller Lake O'Brien, 23; from South Porcupine, Dome Lake, (gold) 31; Porphyry Hill, (gold) 20; from Porquis Junction, Alexo Mine (nickel), 799 tons.

CANADIAN COPPER (Sudbury)—Has given up option on copper property in West Shining Tree on which it was working.

TEMISKAMING (Cobalt)—Has declared 3% dividend; time of payment not being specified. It is 2½ years since company has paid dividend. There is large amount of cash on hand and ore reserves are estimated at about $250,000.

VIPOND (Porcupine)—With reference to rumors of dividend, President Ward states that while results of operations have been satisfactory, it would be premature to consider definite plans for dividend in immediate future. Report covering operations from Apr. 1 to Sept. 30 will be issued soon.

MOOSE MOUNTAIN IRON MINES (Sudbury)—Has been closed. This was largest attempt to work concentrating magnetic iron ores of Northern Ontario. Difficulty was experienced in getting satisfactory briquettes from fines. Over million dollars has been spent by MacKenzie & Mann, and Gates interests.

MANIGOTAGAN GOLD MINING AND DEVELOPMENT CO. (Toronto)—New company formed by Toronto men to operate claims in Gold Lake district of northeastern Manitoba. Section has been known for several years, but recent discoveries are several miles from Rice Lake where first properties were opened up. Development work in that section was unsatisfactory, but new property has all indications of making good. It is in the hands of responsible people and will get a fair chance.

CENTRAL AMERICA

Honduras

NEW YORK & HONDURAS ROSARIO (San Juancito)—The directors and officers of the New York & Honduras Rosario Mining Co. have sent out splendidly engraved announcements, to stockholders and friends, of the Thirty-fifth Anniversary of the company's corporate existence and uninterrupted operation, dating from Nov. 17, 1880.

The Market Report

Metal Markets

NEW YORK—NOV. 24

The outstanding feature of the metal markets last week was the extraordinary strength of copper, which advanced further on large business. Spelter also was stronger. Lead was stationary, but firmer in tone. Tin advanced.

Copper, Tin, Lead and Zinc

Copper—On Thursday, Nov. 18, the market opened at 19c., r.t., on which basis it had become firmly established on the previous day. A large business was done, and before the end of the day 19¼c., r.t., was realized on million-pound lots. The story of the following days is about the same up to Nov. 23, when the market rested at 19¾c., r.t. Some sellers were asking 20c., but, reports to the contrary notwithstanding, this price had not been realized on any important business up to the close of our week of record, and at the close copper was still available in large quantity at 19¾c., r.t.

The advance was orderly throughout the week. Whenever any producer sold all he wanted to at a certain price he raised his asking price ¼c. per lb., while others kept on selling at the previous price until they too had disposed of all they wanted to at that price.

The volume of business done during the week was large, possibly as large as in the previous week. The major portion of it appears to have been done, however, in the early part of the week at prices from 19@19½c., r.t. Business with domestic manufacturers predominated. There was a good demand from wire drawers and an improved demand from the rolling mills. The bulk of the sales was for copper to be delivered the first quarter of 1916. There were some contracts running ahead to May and June. The larger producers report themselves excellently sold up. In some cases the entire expected output for the next four months has been contracted.

Copper Sheets, base price is 24¼c. per lb. for hot rolled and 25¼c. for cold rolled, with usual extras. Copper wire is 20@20¼c. per lb., carload lots at mill.

Copper Exports for the week ended Nov. 6 are reported by the Department of Commerce at 5,820,478 lb., of which 2,241,175 lb. went to Sweden, 1,652,869 to France, 706,337 to Italy, and 508,744 to England. Imports for the week were 953,521 lb. metal and 969,248 lb. in ore and matte; 1,922,769 lb. in all. The chief imports were from Peru, Japan and Canada.

Visible Stocks of Copper in Europe on Nov. 15 were: Great Britain, 15,473; France, 1,645; afloat from Chile, 1,050; afloat from Australia, 3,400; total, 21,568 long tons, a decrease of 3,317 tons from the Oct. 31 report.

Tin—This market experienced a natural reaction from the sharp advance in the previous week. It might have gone further, keeping step with the decline in London, were it not that the supplies of spot tin here are so tightly held. The volume of business during the week was rather light.

Lead—A good business was done, but conditions were quieter than in the previous week. The St. Louis market was a little stronger, especially owing to the sharp demand for chemically hard lead.

Spelter—The conditions in this market are chronically mixed. The change from week to week in the confusion is purely relative, more or less. Last week was one of those in which the confusion was more. Spelter for prompt and early delivery sold up to 18½c. Contracts for December-January-February shipments were taken at 16½@16¾c. Some considerable business for the second quarter of 1916 was done at 14½c. The total volume of business was not very large. The major portion of what was done in some important quarters was for export. Sales to Great Britain were but trifling, the producers reporting that they could not realize the published prices. On the other hand, France was a free buyer. In this country the galvanizers did some buying, out the larger part of the business was with the brass makers. Brass special spelter for delivery during the first quarter of 1916 sold at 18@20c. per lb.

The continued strength of the spelter market causes a good deal of surprise. The explanation offered in a well-informed quarter is the following: The present American consumption for brass is about 240,000 tons, for galvanizing, 100,000 tons, for sheet zinc and miscellaneous purposes, 60,000 tons; the exportation is about 120,000 tons. This gives the total requirement at the rate of 520,000 tons. The present rate of production is probably about that, or only a little in excess of it. The accumulation of unsold stocks so far has been confined to the superior grades of spelter, of which there is undoubtedly an accumulation. The output of the new smelting works has not yet attained large proportions, and probably will not until after the end of this year.

Zinc Sheets base price was advanced ½c. on Nov. 18, making it $19.50 per 100 lb. Nov. 22 there was a further advance and the base price today is $22 per 100 lb., f.o.b. Peru, Ill., less 8% discount. Demand is good.

DAILY PRICES OF METALS IN NEW YORK

Nov.	Sterling Exchange	Silver, Cts. per Oz.	Copper: Electrolytic, Cts. per Lb.	Tin: Spot, Cts. per Lb.	Lead: New York, Cts. per Lb.	Lead: St. Louis, Cts. per Lb.	Zinc: St. Louis, Cts. per Lb.
18	4.6850	51⅞	18.80 @19.00	41	5.25	5.17½ @5.20	15.50 @18.25
19	4.7000	51⅞	19.00 @19.30	40	5.25	5.17½ @5.20	15.50 @18.50
20	4.6913	51⅞	19.05 @19.30	40	5.25	5.17½ @5.20	15.50 @18.50
22	4.6900	52⅛	19.30 @19.55	39½	5.25	5.17½ @5.20	15.50 @18.50
23	4.7013	52⅛	19.50 @19.60	39½	5.25	5.17½ @5.22½	15.50 @18.50
24	4.7000	54½	19.50 @19.60	39	5.25	5.17½ @5.22½	15.50 @18.50

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.20c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Nov.	Silver	Copper: Standard Spot	Copper: Standard 3 Mos.	Copper: Electrolytic £ per Ton	Copper: Electrolytic Cts. per Lb.	Tin: Spot	Tin: 3 Mos.	Lead: £ per Ton	Lead: Cts. per Lb.	Zinc: £ per Ton	Zinc: Cts. per Lb.
18	24 13/16	79¾	79½	94½	19.77	173½	172¼	26 5/16	5.55	87	18.19
19	25	81½	80¾	95½	20.03	172½	171	27	5.67	98	20.64
20	24⅞	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	25⅛	82¾	82¾	96½	20.22	172	170	27⅜	5.74	100	20.92
23	25⅜	81¾	82½	98	20.55	168¾	167¼	27¼	5.83	100	20.96
24	26¼	80½	80¾	98½	20.66	166¼	165¼	27	5.67	100	20.96

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

Other Metals

NEW YORK—Nov. 24

Aluminum—Conditions in the market are not changed, and metal for early delivery commands a high price. Futures are lower. Current quotations are 57@59c. per lb. for No. 1 ingots, New York. As high as 60c. is reported paid for one lot.

Antimony—Supplies are scarce and futures uncertain, owing to the difficulty about arranging for shipments of Chinese, and delays in transit. Business has been on a small scale this week, and prices have advanced again, ordinary brands bringing 39@41c. per lb. Cookson's is quoted at 47c. per lb., but is almost wholly nominal, as very little is to be had.

Antimony ore is also scarce. Only a small quantity is offered at about $2.40 per unit.

Quicksilver—Prices continue high in view of a good demand, with only moderate stocks. New York quotations are $105 per flask of 75 lb. for large quantities and up to $110 for smaller orders. San Francisco reports by telegraph an active market, with sales up to $105 per flask. London price remains £16 10s. per flask, with no discount from second hands.

Nickel—There is no change to be noted. Ordinary forms are still nominally 45@50c. per lb., according to size and terms of order. Electrolytic nickel is 3c. higher. The exports have been about the same as last year, a decrease in shipments to Germany being made up by an increase in those to Great Britain.

Minor Metals—Current quotations for **Bismuth** are $3 per lb., New York.—**Cadmium** is quoted at 7s. per lb. in London; $1.75@1.90 per lb., New York.—**Chromium metal,** 75c. per lb., New York.—**Cobalt metal,** 97% pure, is sold at $2 per lb.—**Magnesium,** pure, has gone to a high price, $6 per lb. being asked.—**Selenium** varies from $2.50@3 per lb., New York, for large lots; $4.50@5 for retail quantities.

Gold, Silver and Platinum

NEW YORK—Nov. 24

Gold production in the Transvaal in October was 797,631 oz., being 20,881 oz. more than in September, and 63,885 oz. more than October, 1914. For the 10 months ended Oct. 31 the production was 6,967,166 oz. in 1914, and 7,531,547 oz.—or $155,667,076—in 1915; an increase of 564,381 oz. this year.

Actual arrivals of gold from Europe at New York were $15,750,000 for the week.

Exports of gold from Australia in the months of July and August were £3,468,676, which compares with £444,271 in the corresponding months of 1914. The large increase this year was mainly in shipments to San Francisco from Sydney.

Platinum—Prices are still rising, and are fast becoming altogether nominal, each transaction being a separate negotiation. Sales have been made from $64 up to $70 per oz. for refined platinum. Some dealers decline to quote.

Silver—The silver market has suddenly advanced, owing to combined buying on Mint orders and on India and continental account. It closed at 26¼d. in London and 54½c. in New York.

Shipments of silver from London to the East Jan. 1 to Oct. 27, as reported by Messrs. Pixley & Abell:

	1914	1915	Changes
India	£4,679,500	£3,394,000	D. £1,285,500
China	42,000	6,250	D. 35,750
Total	£4,721,500	£3,400,250	D. £1,321,250

China has been taking very little silver this year, having sold as much or more as has been received in the country.

EXPORTS AND IMPORTS

Imports and Exports of the Minor Metals in the United States eight months ended Aug. 31, in pounds except platinum which is in ounces:

	Imports		Exports	
	1914	1915	1914	1915
Nickel	27,080,939	34,159,151	19,203,732	20,001,725
Antimony	10,031,198	12,942,755	3,673	950,867
Aluminum	10,559,359	6,332,873	18,939	40,102
Quicksilver	.....	.....	24,441	150,042
Platinum, oz.	51,821	27,002	143	9

Exports include reëxports of foreign material. Exports of aluminum manufacturers—not included above—were valued at $642,133 in 1914, and $2,678,770 in 1915. Nickel and antimony include contents of ore, matte and regulus.

The tin smelting plant of the American Smelting and Refining Co. at Perth Amboy, N. J., will start up about Jan. 1, it is expected. The initial capacity will be 750 tons monthly.

Exports and Imports of Secondary Metallic Products in the United States, eight months ended Aug. 31, in pounds:

	Exports		Imports	
	1914	1915	1914	1913
Copper sulphate	6,925,087	10,038,396	.....	.....
White lead	12,201,138	15,926,023	.....	.....
Zinc oxide	20,069,717	28,473,070	.....	.....
Zinc dust	47,557	293,358	3,025,911	903,738
Zinc dross	648,631	7,387,208	.....	.....

The exports of zinc dust reported were all reëxports of foreign material.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Nov. 20

The base price paid this week for zinc ore was $100@108 for 60% grades. The base price paid for 80% lead ore was $64 per ton.

SHIPMENTS, WEEK ENDED, NOV. 20

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	4,796,000	310,000	831,300
Year	183,567,750	6,338,640	25,693,990

Shipped during week to separating plants, 5,044,000 lb. zinc ore.

JOPLIN, MO.—Nov. 20

Blende, high price $118; base per ton 60% zinc, premium ore, $115; medium, $114@105; lower grades down to $100; calamine, base per ton 40% zinc, $80@70; average selling price, all grades of zinc, $101.67 per ton. Lead, high settling price, $65.75, base per ton 80% metal content, $64@70; average selling price, all grades of lead, $62.50 per ton.

SHIPMENTS WEEK ENDED NOV. 20

	Blende	Calamine	Lead	Values
Totals this week..	13,307,750	2,238,480	2,360,100	$864,100
Totals this year...	519,789,440	38,661,560	81,149,870	$23,510,480

Blende value, the week, $715,500; 47 weeks, $20,407,500.

Calamine value, the week, $74,850; 47 weeks, $955,080.

Lead value, the week, $73,750; 47 weeks, $2,147,900.

Sellers held out until noon Friday for $125 for premium ore, but buyers would not offer in excess of $115 and transactions were made at this figure. The advance for blende was $5; calamine advanced $10 and lead $6 per ton. The bulk of reserve ore has been held at Granby, 1,200 tons of the 4,000 tons being shipped this week, with the sale of another 1,000 tons for next week's shipment. Practically all smelting companies closed the week with large purchases for next week's delivery.

Iron Trade Review

NEW YORK—Nov. 24

The iron and steel markets are now fairly on the boom. The mills are everywhere full of orders and in some cases premiums are being asked for early deliveries.

The rush is not all for export trade, as domestic orders are piling up steadily and price advances have not checked the demand. The latest branch of the trade to show rising activity is structural steel. Orders for new construction are being placed rapidly. The demand for plates and shapes for shipbuilding have added to the rush, while new cars are being rather freely contracted for.

Exports from Baltimore for the week included 1,824,700 lb. tinplates to Glasgow.

The pig-iron market is strong and advances of 50c. per ton are recorded. Foundry-iron demand has shown a notable increase, and in some cases early deliveries are sought. Furnaces are going into blast where it is possible, and it looks as if November and December would improve upon the record production of October.

PITTSBURGH—Nov. 23

Buyers of steel seem to be exerting as much pressure as ever to secure the acceptance of orders by steel mills. Recent advances in steel prices were made with the full expectation that demand would be curtailed thereby, the mills feeling amply strong to stand such a decrease, and in the circumstance of demand being as heavy as ever further price advances are now predicted. Last Thursday noon the Carnegie Steel Co. advanced its price on bars, plates and shapes from 1.60c. to 1.70c., and the advanced price was at once adopted by other mills, making a total advance in these products from 1.40c. to 1.70c., or $6 a ton, in five weeks. Galvanized sheets are up $5 a ton, to a range of 4.50 to 4.75c., black sheets being stronger at 2.40 to 2.50 cents.

Steel interests are canvassing all possibilities of increasing production, but erection work promises to be slow and new construction is undertaken only where the conditions are particularly favorable. Pig iron and steel making capacity will not increase by more than a very few per cent. in the next twelve months, by additions at various points and the

completion of a few complete plants that have been under way for a long time.

The Pennsylvania R.R. system on Saturday decided not to buy any freight cars, finding prices and deliveries proposed under its inquiries for 9,000 cars unsatisfactory. The plate mills involved profess relief that the business is postponed. Other roads are slower than was expected in placing car orders, but nevertheless at least 15,000 freight cars have been bought thus far this month.

Inquiry for structural material has increased, indicating at least fairly heavy building operations next season. The demand for structural steel to date has been conspicuously light as compared with demand for other steel products.

Prices on Lake Superior ore for the season of 1916 are likely to be announced before the week is out, at an advance of 75c. or $1 a ton over the schedule obtaining in the past season, these prices having been the same as for 1912 and 1914 and the lowest since 1904. In ore circles it is stated that all the ore available can be sold in a few weeks, large reservations having already been made, and that the limit will be fixed by lake transportation facilities, rather than by mining capacity, and at 55,000,000 to 60,000,000 tons for the season, against the previous record of approximately 50,000,000 tons in 1913.

Pig Iron—The Republic Iron & Steel Co. has bought 25,000 tons of bessemer pig iron from a Shenango Valley furnace interest at $17 at furnace for shipment over the first three months of next year, the market thus being established at an advance of 50c. A few small lots had already been sold at the figure. Offerings of basic iron are limited and an early advance is predicted, with possibilities of continued and sharp advances as there are only two idle merchant furnaces now in the general district. Foundry iron is stiffening sharply, even in the face of a rather light demand, and quotations are 50c. higher than a week ago, with some furnaces quoting above the general range. We quote: Bessemer, $17; basic, $16@16.25; foundry and malleable, $16@16.50; forge, $15.50@16, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—Supplies from England are coming in more freely. The English price on contract is steady at $100, Baltimore, while domestic producers may possibly occasionally shade their former quotation of $110 on contract.

Steel—Quotations are difficult to obtain on bessemer steel, while openhearth is scarcely quoted at all, mills being completely sold up for near-by positions and being unwilling to quote for late deliveries. The market is regarded as quotable approximately at the following advanced figures, though the prices are largely nominal: Bessemer billets, $27; bessemer sheet bars, $28; openhearth billets, $28@29; openhearth sheet bars, $28.50@29, f.o.b. maker's mill, Pittsburgh or Youngstown. Rods are about $35 and forging billets about $48 at mill.

FERROALLOYS

Ferrosilicon, 50%, is quoted $83@85, Pittsburgh, according to quantity. Bessemer ferrosilicon is quoted from $33 for 16% down to $23 for 10%, all at furnace.—**Ferrotitanium** is 8@12½c. per lb., according to size of order.—**Ferrotungsten** continues to command high and irregular prices. A sale of **Tungsten** metal, 98% pure was made this week at $7 per lb. for a lot of 500 lb.; and higher prices are expected.

IRON ORE

The leading ore shippers on the Lakes came into the market last week and chartered all the available tonnage to carry ore next season. These charters were made at an advance of 10c. over those for the season just ending, making the rate net to the ship for 1916 delivery 50c. from the head of the lakes, 45c. from Marquette and 35c. from Escanaba.

The anticipated need of a larger quantity of iron ore than had been expected, combined with delays in November ore shipments caused by bad weather, have made heavy shipments of ore imperative in the short time remaining of the season. About all the wild boats available have been chartered, and it is understood that $1 a ton has been paid for ore from Duluth to a Lake Erie port.

Shipments of iron ore from deposits near Waukon, Iowa, are being made to South Chicago, where the ore will be used in the Iroquois Iron Co.'s stacks as an experiment. Possible shortage of Lake Superior ore has led the company to seek a reserve supply from Iowa and tests will be made at once to determine the practicability of its use in ordinary practice. Several thousand tons have been contracted for.

Imports and Exports of Iron Ore in the United States nine months ended Sept. 30, in long tons:

	1914	1915	Changes
Imports	1,094,972	971,098	D. 123,874
Exports	536,115	508,557	D. 27,558

Leading imports this year were 610,698 tons from Cuba and 151,619 tons from Sweden.

British Iron Ore Imports 10 months ended Oct. 31 were 4,986,518 tons in 1914, and 5,108,770 in 1915; increase, 122,252 tons.

OTHER ORES

Manganese Ore—In Great Britain, according to the London "Mining Journal," October imports were above the average, amounting to 60,931 tons, but owing to the fact that freights entirely govern business shipments are necessarily irregular. Prices remain nominal, but business has been done this week at from 1s. 8d. to 1s. 9d. The situation in India is one of sharp competition between sellers, the f.o.b. rates ruling there being from 6 to 6½d., with occasional shading. The conditions of war are tending to reduce output, and stocks are diminishing. The Bombay figures on Oct. 22 last were 85,649 tons.

Imports of manganese ore in the United States nine months ended Sept. 30 were 215,274 tons in 1914, and 173,992 tons in 1915; a decrease of 41,282 tons this year.

Imports of manganese ore in Great Britain 10 months ended Oct. 31 were 444,975 tons in 1914, and 270,745 tons in 1915; decrease, 174,230 tons.

COKE

Production in the Connellsville region for the week is reported by the "Courier" at 427,381 short tons coke; shipments 430,503 tons. Shipments of Greensburg and Upper Connellsville districts were 42,815 tons.

Connellsville—The market for prompt furnace coke is easier, there being offerings down to $2.15, while $2.10 has been done on one or two odd lots. Corrigan, McKinney & Co. are understood to have closed for their remaining requirements for next year, leaving very little uncovered contract business. We quote: Prompt furnace, $2.15@2.25; contract, first half, $2.35@2.50; year 1916, $2.25@2.35; prompt and contract foundry, $2.90@3.25, per net ton at ovens.

Exports and Imports of Fuel in the United States nine months ended Sept. 30, in long tons:

	Exports		Imports	
	1914	1915	1914	1915
Anthracite	3,062,057	2,594,754	18,257	2,524
Bituminous	10,902,780	12,421,960	980,284	1,077,799
Coke	485,171	573,084	83,980	36,602
Bunker coal	5,711,948	5,678,815	.....	.....
Total	20,161,956	21,268,613	1,082,521	1,116,925

The bunker coal or coal furnished to steamships in foreign trade is practically all bituminous. The principal trade, both exports and imports, is with Canada.

Chemicals

NEW YORK—Nov. 24

The General Chemical Co. has declared an extra dividend of 15% on its common stock, payable in new stock. At the same time it is paying its employees a bonus of 10% on their yearly salaries.

Arsenic—Business is quiet, without change. Current quotations are $3.75@4 per 100 lb. for both spot and future deliveries.

Copper Sulphate—Business is steady and sales about as usual. Prices have been advanced and the current quotation is $8 per 100 lb. for carload lots and $8.25 per 100 lb. for smaller parcels.

Nitrate of Soda—Business is fair and prices are a little stronger. High ocean freights are keeping up the quotation. The current figure is $2.90@2.95 per 100 lb. for spot and December; $2.85 for later deliveries.

Pyrites—Imports at Baltimore for the week included 5,983 tons pyrites from Huelva, Spain.

Sulphuric Acid—60° Bé. acid is selling at $60 per ton, f.o.b. works.

Imports and Exports of Fertilizing Chemicals in the United States eight months ended Aug. 31, in long tons:

	Imports		Exports	
	1914	1915	1914	1915
Kainit	317,265	6,646	.....	.....
Manure salts	150,973	13,647	.....	.....
Other potash salts	182,091	67,427	2,746	900
Nitrate of soda	371,952	555,846	6,114	14,779
Sulphate of ammonia	51,483	25,745	.....	1,204
Phosphates	.....	.....	899,100	157,806

Exports include reëxports of foreign material. Some phosphates are imported, but are not given separately in the returns.

PETROLEUM

Shipments of Mexican oil to the United States in October from Tampico were 986,616 bbl.; from Tuxpam, 681,968; total, 1,668,584 bbl. This does not include shipments to Europe.

Assessments

Company	Delinqe	Sale	Amt.
Blue Bull Reorg., Nev.	Nov. 1	Dec. 6	0.01
Clear Grit, Ida.	Dec. 14	Jan. 5	0.0015
Coeur d'Alene Inv., Ida.	Oct. 25	Dec. 6	0.002
Columbus Ext., Utah.	Dec. 11	Jan. 3	0.02
Cons. Imperial, Nev.	Nov. 30	Dec. 21	0.01
Copper Mt. M. & D., Ida.	Oct. 28	Dec. 1	0.002
Danley-Lloyd, Utah	Nov. 14	Nov. 30	0.0025
Darby M. & M., Ida.	Nov. 16	Dec. 16	0.00125
Dry Canon Cons., Utah	Dec. 18	Jan. 17	0.001
Eastern Star, Ida.	Oct. 29	Nov. 29	0.002
Emerald Oil, Utah	Nov. 27	Dec. 16	0.06
Eureka M. & M., Ida.	Nov. 26	Dec. 27	0.001
Great Western, Nev.	Nov. 15	Dec. 7	0.001
Hancock Cons., Mich.	Jan. 3		1.00
Hector, Ida.	Nov. 18	Dec. 10	0.005
Idaho & Los Angeles, Ida.	Nov. 26	Dec. 27	0.005
Idaho-Nevada Exp., Ida.	Nov. 1	Dec. 1	0.002
Ivanhoe, Ida.	Nov. 8	Dec. 9	0.0025
Jack Waite, Ida.	Nov. 20	Dec. 20	0.01
Laclede, Ida.	Dec. 6	Dec. 27	0.003
Leonora M. & M., Utah	Nov. 27	Dec. 17	0.005
Lucky Swede, Ida.	Nov. 11	Dec. 11	0.002
Military M. & M., Ida.	Oct. 28	Nov. 29	0.0065
Missoula Copper, Ida.	Nov. 15	Dec. 15	0.002
Montana Standard.	Nov. 15	Dec. 15	0.005
National Copper, Ida.	Nov. 20	Dec. 18	0.01
National Lead, Ida.	Nov. 15	Dec. 15	0.001
Nevada-Douglas, Nev.	Nov. 30	Dec. 31	0.10
New Arcadian, Mich.	Dec. 1		0.50
New Baltic, Mich.	Jan. 15		0.50
Northern Light, Ida.	Nov. 2	Dec. 2	0.004
O. K. Ex. M. & R., Utah.	Nov. 20	Dec. 15	0.005
Old Vetearn, Ida.	Nov. 1	Nov. 27	0.002
Oom Paul Con., Ida.	Nov. 16	Dec. 6	0.01
Oriental, Nev.	Nov. 6	Dec. 7	0.003
Original, Nev.	Nov. 6	Dec. 7	0.003
Pacific M. & M., Ida.	Nov. 10	Nov. 30	0.0005
Phoenix, Mich.	Jan. 1		1.00
Rescue Eula, Nev.	Dec. 6	Jan. 10	0.01
Seg. Belcher & Midas, Nev.	Dec. 12	Jan. 6	0.02
Silver Cliff, Ida.	Nov. 8	Dec. 6	0.0025
Sonora M. & M., Ida.	Nov. 4	Dec. 17	0.003
Sunset Dev., Ida.	Dec. 8	Jan. 3	0.002
Sunshine, Ida. (post.)		Dec. 15	0.0006
Ton. Gipsy Queen, Nev.	Oct. 29	Dec. 6	0.01
Tonopah Midway, Nev.	Dec. 11	Jan. 11	0.01
Umatilla Ton., Nev.	Nov. 8	Dec. 13	0.005
Wolf Mountain, Utah.	Nov. 12	Dec. 14	0.0025

Stock Quotations

The General Development Co. has announced that it will make the par value of its shares $25, issuing four for each one now outstanding.

COLO. SPRINGS Nov. 22		SALT LAKE Nov. 22	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.02¾	Beck Tunnel	.06½
Cripple Cr'k Con.	.01	Black Jack	.05
C. K. & N.	‡.02	Colorado Mining	.05
Doctor Jack Pot.	.09¾	Crown Point	.01
Elkton Con.	.28½	Daly-Judge	7.20
El Paso	.79	Emma Cop.	.26
Findlay	.03½	Gold Chain	.52
Gold Dollar	.02	Grand Central	.52
Gold Sovereign	.05⅞	Iron Blossom	.85
Golden Cycle	1.83	Lower Mammoth	.07¼
Isabella	.19½	May Day	.17
Jack Pot	.06½	Opohongo	.00½
Jerry Johnson	.05	Prince Con.	.81
Lexington	‡.005	Seven Troughs	.01½
Mary McKinney	.44	Silver King Coal'n	2.25
Pharmacist	‡.008	Silver King Con.	2.32½
Portland	1.71	Sioux Con.	.02½
Raven B. H.	.03¾	Uncle Sam	.07½
Washington	1.66½	Yankee	.30½

TORONTO Nov. 22			
Bailey	.04¼	Dome Exten	.28½
Chambers Ferland	.19¼	Foley O'Brien	.55
Coniagas	4.00	Hollinger	26.25
Peterson Lake	.31½	Imperial	.04
Right of Way	‡.04	Jupiter	.13
Seneca Superior	.70	McIntyre	.75
Silver Queen	‡.01	Pearl Lake	‡.00½
T. & Hudson Bay	20.00	Porcu. Crown	.78
Timiskaming	.48	Preston E. D.	.04½
Trethewey	‡.13	Vipond	.77
Wettlaufer-Lor.	‡.07	West Dome	.08½

SAN FRANCISCO Nov. 22			
Alta	‡.04	Belmont	4.25
Andes	.10	Jim Butler	.93
Best & Belcher	.06	Lone Star	.03
Caledonia	.49	MacNamara	.03
Challenge Con.	‡.06	Midway	.12
Chollar	‡.02	Mont.-Tonopah	.32
Confidence	.16	North Star	13.00
Con. Virginia	.22	Rescue Eula	.07
Gould & Curry	.04	West End Con.	.74
Hale & Norcross	.04	Atlanta	.25
Jacket-Cr. Pt.	.16	Blue Bell	.03
Julia	‡.02	Booth	.38
Mexican	.37	C.O.D. Con.	.04
Occidental	.75	Comb. Frac	.07
Ophir	.28	D'field Daisy	.03
Overman	.08	Jumbo Extension	1.17½
Potosi	‡.02	Pitts.-Silver Peak	.06
Savage	.06	Round Mountain	.41
Sierra Nevada	.47	Sandstorm Kendall	.09
Union Con.	.56	Silver Pick	.07
Utah Con.	.03	Central Eureka	.08

N. Y. EXCH. Nov. 22		BOSTON EXCH Nov. 22	
Name of Comp.	Clg.	Name of Comp.	Clg.
Alaska Juneau	11¼	Adventure	‡2
Am.Sm.&Ref.,com.	97	Ahmeek	‡397
Am. Sm. & Ref., pf.	111½	Alaska Gold M.	27½
Am. Sm. Sec., pf. A	91½	Algomah	1½
Am. Sm. Sec., pf. B.	85	Allouez	57½
Anaconda	88½	Am. Zinc	70⅜
Batopilas Min.	1⅛	Ariz. Com., ctfs.	8
Bethlehem Steel	468	Bonanza	‡.30
Bethlehem Steel, pf.	161½	Butte-Balaklava	3½
Chino	54½	Butte & Superior	72½
Colo. Fuel & Iron.	51½	Calumet & Ariz.	69½
Crucible Steel	75⅛	Calumet & Hecla	570
Dome Mines	25½	Centennial	17½
Federal M. & S., pf.	50½	Copper Range	62
Great Nor., ore., ctf.	50½	Daly West	2½
Greene Cananea	45⅛	East Butte	15⅛
Guggen. Exp.	79⅛	Franklin	9½
Homestake	120½	Granby	84
Inspiration Con.	45½	Hancock	17
International Nickel	185	Hedley	‡28
Miami Copper	34⅛	Helvetia	.45
Nat'l Lead, com.	64⅜	Indiana	5½
National Lead, pf.	109½	Island Cr'k, com.	‡43
Nev. Consol.	16⅛	Island Cr'k, pfd.	‡89
Ontario Min.	6	Isle Royale	28⅛
Quicksilver	3½	Keweenaw	2⅛
Ray Con.	26⅛	Lake	13⅛
Republic I&S, com.	51	La Salle	‡6
Republic I&S, pf.	108⅜	Mason Valley	1.85
Tennessee Copper	58	Mass	13
Utah Copper	77⅛	Mayflower	‡4½
U. S. Steel, com.	86⅛	Michigan	‡2½
U. S. Steel, pf.	116	Mohawk	86⅛
		New Arcadian	10½

N. Y. CURB Nov. 22			
Alta Con.	.12	North Butte	32½
Beaver Con.	.32	North Lake	‡1⅛
Big Four	.05	Ojibway	1⅛
Braden Copper	16	Old Colony	3½
Buffalo Mines	.50	Old Dominion	59⅛
Can. Cop. Corpn.	2⅛	Osceola	86½
Cashboy	.06	Quincy	91
Cerrode Pasco	39½	Santa Fe	3⅛
Chile Cop.	25⅛	Shannon	7⅛
Con. Ariz. Sm.	1 5/16	Shattuck-Ariz.	36
Con. Coppermines	2	Superior	28
Con. Nev.-Utah	5/16	Superior & Bost.	‡2½
Dia. Black B.	.05½	Tamarack	‡56
Florence	.40	Trinity	10⅛
Goldfield Con.	1 1/16	Tuolumne	.35
Goldfield Merger	.18	U. S. Smelting	47½
Howe Sound	4	U. S. Smelt'g, pf.	48
Kennecott Cop.	54	Utah Apex	3⅛
Kerr Lake	4	Utah Con.	‡13⅛
La Rose	.75	Victoria	‡2⅛
Magma	15	Winona	3⅛
McKinley-Dar-Sa.	.40	Wolverine	59
Mines of Am.	2⅛	Wyandot	‡1½
Mother Lode	.34		
Nevada Hills	.17		
New Utah Bingham	2½		
Nipissing Mines	7		
Oro	.06		
St. Joseph Lead	14⅛		
South Utah	‡.30		
Stand'd Oil of N.J.	500		
Standard S. L.	1⅛		
Stewart	9/16		
Success	.65		
Tonopah	6⅛		
Tonopah Ex.	3⅛		
Tonopah Merger	.42		
Tribullion	.75		
Yukon Gold	2⅛		

LONDON Nov. 12		BOSTON CURB Nov. 22	
Alaska Tre'dwell	£6 17s 6d	Bingham Mines	8½
Burma Corp.	1 12 6	Boston Ely	.45
Cam & Motor	0 13 6	Butte & Lon'n Dev.	.40
Camp Bird	0 7 9	Calaveras	1⅛
El Oro	0 10 0	Calumet-Corbin	.05
Esperanza	0 11 0	Chief Con.	1⅛
Mexico Mines	4 6 9	Cortez	.45
Nechi, pfd.	0 12 6	Crown Reserve	.57
Oroville	0 14 3	Davis-Daly	1⅛
Santa Gert'dis	0 10 6	Eagle & Blue Bell	1 1/16
Tomboy	1 4 6	First Nat. Cop.	6½
Tough Oakes	0 7 6	Houghton Copper	2⅛
		Iron Cap Cop., pf.	7
		Majestic	.93
		Mexican Metals	.35
		Nevada-Douglas	.69
		New Baltic	3½
		New Cornelia	9½
		Ohio Copper	.21
		Oneco	1
		Raven Copper	.12
		Rex Cons.	.32
		Smokey Dev.	.15
		So. Lake	5½
		Tonopah Victor	.32
		United Verde Ext.	5½
		Utah Metal	10

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	59.499	58.519	50.250	27.416	26.958	23.709
May	60.361	58.175	49.915	27.825	26.704	23.570
June	58.990	56.471	49.034	27.199	25.948	23.267
July	58.721	54.678	47.519	27.074	25.219	22.597
August	59.293	54.344	47.163	27.335	25.979	22.780
September	60.640	53.290	48.680	27.986	24.260	23.591
October	60.793	50.654	49.385	28.083	23.199	23.925
November	58.995	49.082		27.263	22.703	
December	57.760	49.375		26.720	22.900	
Year	59.791	54.811		27.576	25.314	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Electrolytic	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	14.787	64.276	66.152	69.170	*
April	14.211	16.811	64.747	75.096	69.313	*
May	13.996	18.506	63.182	77.600	67.786	*
June	13.603	19.477	61.336	82.574	66.274	95.333
July	13.223	18.796	60.540	76.011	64.955	91.409
August	*	16.941	‡	68.673	‡	82.333
September	*	17.502	‡	68.915	‡	85.250
October	*	17.686	‡	72.601	‡	88.000
November	11.739		53.227		*	
December	12.801		56.841		*	
Year						

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	48.426	173.619	180.141
April	36.154	47.884	163.963	166.225
May	33.360	38.790	150.702	162.675
June	30.577	40.288	138.321	167.636
July	31.707	37.423	142.517	167.080
August	*	34.389	‡	151.440
September	32.675	33.125	‡	152.625
October	30.284	33.080	‡	151.554
November	33.304		139.391	
December	33.601		147.102	
Av. year	34.301			

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3.937	3.718	19.606	19.122
March	3.970	4.053	3.850	3.997	19.651	21.883
April	3.810	4.221	3.688	4.142	18.225	21.094
May	3.900	4.274	3.808	4.182	18.503	20.347
June	3.900	5.932	3.810	5.836	19.411	25.170
July	3.891	5.659	3.738	5.531	19.051	24.611
August	3.875	4.656	3.715	4.520	‡	21.946
September	3.828	4.610	3.658	4.490	‡	23.151
October	3.528	4.600	3.384	4.499	‡	23.994
November	3.683		3.585		18.500	
December	3.800		3.662		19.097	
Year	3.862		3.737			

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.1½	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	10.012	4.963	9.837	21.569	49.888
May	5.074	14.781	4.924	14.610	21.393	69.100
June	5.000	21.208	4.850	21.038	21.345	100.614
July	4.920	19.026	4.770	18.856	21.568	97.250
August	5.568	12.781	5.418	12.611	‡	67.786
September	5.380	13.440	5.230	13.270	‡	67.841
October	4.909	12.800	4.750	12.596	‡	66.536
November	5.112		4.962		25.016	
December	5.592		5.430		27.369	
Year	5.213		5.061			

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	14.55	14.12	13.45	14.08	13.90
March	15.07	14.55	13.91	13.45	14.10	13.95
April	14.90	14.55	13.90	13.45	14.13	13.95
May	14.90	14.61	13.90	13.60	14.27	13.83
June	14.90	14.70	13.90	13.67	13.96	13.77
July	14.90	14.94	13.90	13.91	13.90	13.68
August	14.90	16.01	13.90	15.31	14.08	14.75
September	14.90	16.86	13.90	15.95	14.03	15.70
October	14.84	16.95	13.75	15.96	13.97	15.80
November	14.59		13.43		13.83	
December	14.70		13.45		13.83	
Year	$14.88		$13.78		$14.01	